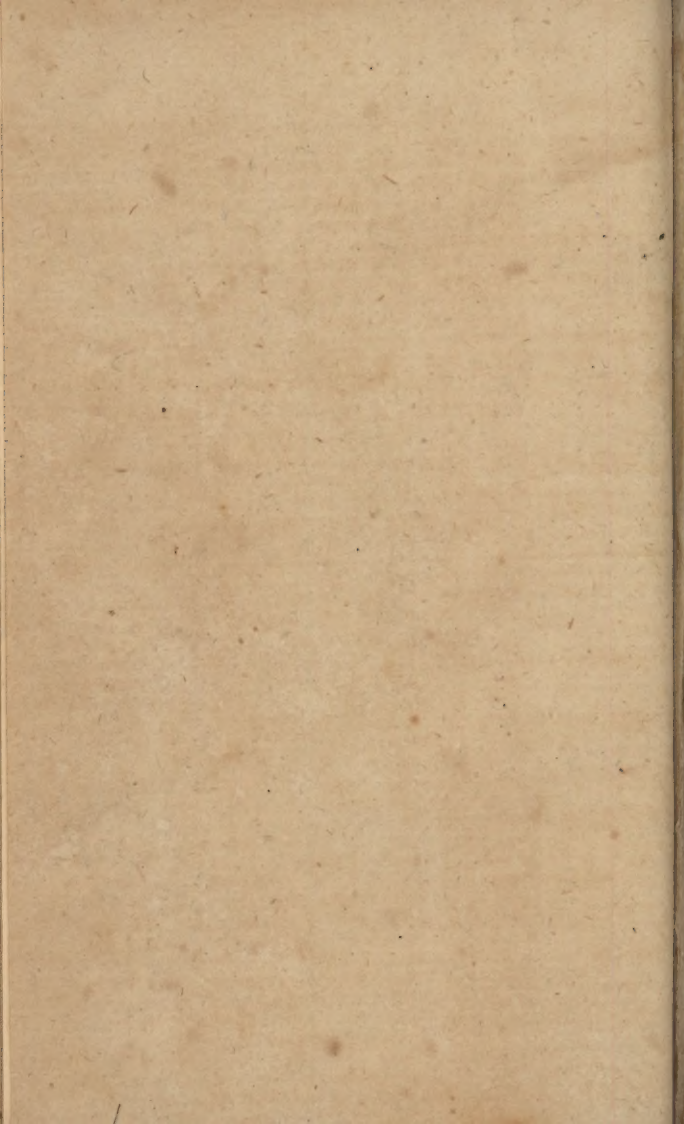


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THE  
GOLDEN CABINET:

BEING THE  
*LABORATORY,*

OR  
HANDMAID to the ARTS.

CONTAINING

*Such Branches of Useful Knowledge,*

*As nearly concerns all Kinds of People,*

From the SQUIRE to the PEASANT:

AND WILL AFFORD BOTH

PROFIT and DELIGHT.

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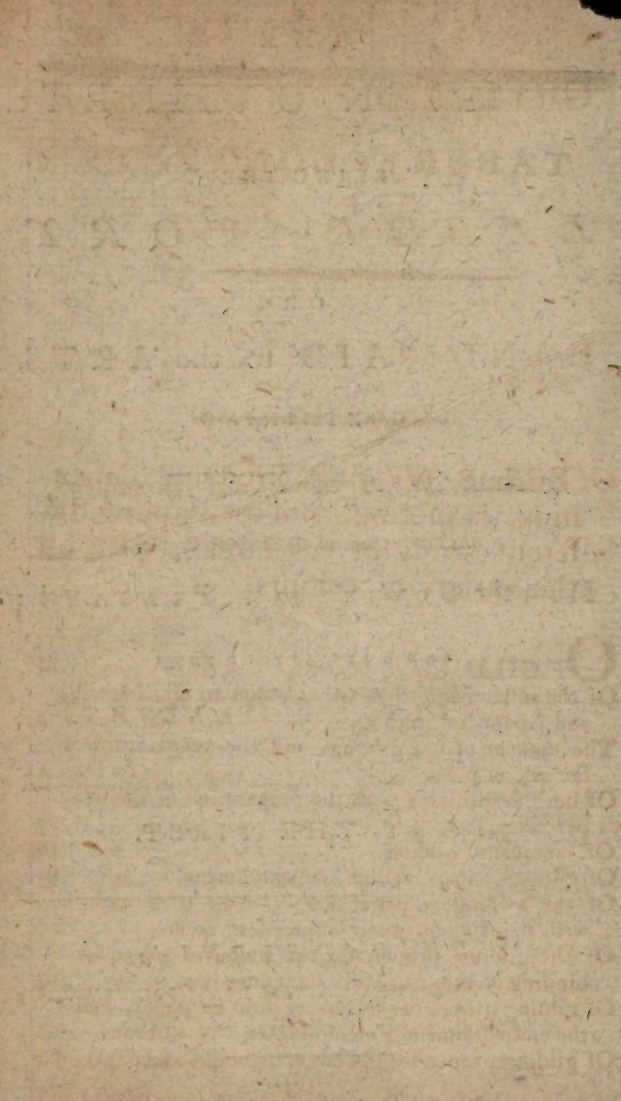
PART THE FIRST.

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1793.



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# THE SCHOOL of ARTS.

Of gilding, silvering, bronzing, japanning, laquering, and the staining different kinds of substances, with all the variety of colours.

---

## PART I.

---

### *Of gilding in general.*

THE gilding different substances is performed by a variety of means accommodated to the nature of each. But the principle is the same in all; (except with respect to one kind practised on metals, where quicksilver and heat is used, which I omit here as not properly a part of the subject of this work;) being only the putting some proper cement on the body to be gilt; and then laying the gold either in the form of leaves, or powder, on the cement; which binds it to the body. The principal kinds of gilding are those called *oil gilding*;—*burnish gilding*;—and *japanners gilding*, or *gilding with gold size*. These may be promiscuously used on grounds either of wood, metal, or any other firm or rigid body: but paper and leather require a treatment in some cases peculiar to themselves. The first attention, in most kinds of gilding, is the choice of leaf gold: which should be pure, and of the colour accommodated to the purpose, or taste of the work. Purity is requisite in all cases: for if the gold be alloyed with silver, it will be of too pale and greenish a hue for any application; and if it contain much copper, it will in time turn to a yet much stronger green. The purity may be ascertained with

accuracy enough for this purpose, by the touchstone, and *aqua fortis*; and the fitness of the colour, to any particular purpose, may be distinguished by the eye. The full yellow is certainly the most beautiful and truest colour of gold: but the deep reddish cast has been of late most esteemed from the caprice of fashion. Whichever may be chosen, the colour ought nevertheless to be good of the kind; for there is a great variation in the force and effect of different parcels of the same teint; some appearing more foul and muddy; others bright and clear. The best method however of judging of the colour of leaf gold with nicety, is by keeping a specimen of such as is perfect; with which any fresh parcel may be occasionally compared. There is, besides the true leaf gold, another kind in use, called Dutch gold: which is copper gilt, and beaten into leaves like the genuine. It is much cheaper; and has, when good, greatly the effect of the true, at the time of its being laid on the ground; but with any access of moisture, it loses its colour, and turns green in spots; and, indeed, in all cases, its beauty is soon impaired, unless well secured by laquer or varnish. It is nevertheless serviceable for coarser gilding, where large masses are wanted; especially where it is to be seen by artificial light, as in the case of theatres: and if well varnished, will there in a great measure answer the end of the genuine kinds. The other preparations of gold, belonging to particular kinds of gilding, I shall treat of them, as likewise the cements or other substances employed, in their respective places; and proceed now to show, what the instruments are, which are common to the three principal methods.

*Of the instruments that are common to oil, burnish, and japanners, gilding.*] The first necessary instrument is, a cushion for receiving the leaves of gold from the paper, in order to its being cut into proper size and figures, for covering the places to be gilt. This cushion should be made of leather, and fastened to a square board, which should have a handle. It may be of any size, from fourteen inches square to ten; and should

be stuffed betwixt the leather and board with fine tow or wool; but in such a manner, that the surface may be perfectly flat and even. A proper knife is the next, and an equally requisite instrument; as it is necessary in all cases to cut or divide the gold into parts correspondent to those, which are to be covered. This knife may be the same in all respects as those used in painting, called *pallet knives*; the blade of which may be four or six inches long, and somewhat more than half an inch in breadth, with a handle proportionable. A squirrel's tail is likewise generally provided, for taking up the whole leaves, and for compressing the gold to the surface where it is laid, and giving it the position required. It is used also by some for taking up the parts of leaves; but this is better done by means of a ball of cotton wool; which will both answer this end, and that of compressing the gold in a more easy and effectual manner. This squirrel's tail is cut short, and sometimes spread in the fan-fashion by means of a piece of wood formed like a pencil stick, but broad at one end, and split to receive the tail; but it will equally serve the purpose in its own form, when the hair is cut to a proper length. This instrument is by some called a *pallet*; but improperly; as the board for holding the colours in painting, and which is frequently in use along with this, being called by the same name, would necessarily produce a confusion in speaking of either. A brush of very soft hog's hair, or of the fitch kind, made large, is likewise commonly used for passing over the work when it is become dry, in order to take off the loose gold. Some fine cotton wool is also necessary for taking up the smaller parts of the leaves, and laying them on the work: as also for compressing and adjusting them when laid on. The cotton should be formed into a ball, by tying it up in a piece of fine linen rag; for if it be used without the rag, the fibres adhere to the gold size, and embarrass the work. A small stone and mullar, with a proportionable palette knife, are required for grinding and tempering the mixtures made of the fat oil, or gold size, with each other, and the co-

lours that may be added to them. Proper brushes are also wanted for laying on, and spreading the fat oil, or size, on the work : and some of these should be brushes of different sizes; in order to convey and settle the gold, where the relief of carved work forms deep hollows. These are all the instruments that are common to all the three principal kinds of gilding ; such as are peculiar to each, I shall take notice of where they more properly occur.

*The manner of oil gilding, and the preparation of fat oil.*] The gilding with oil is the most easy and cheap, as well as most durable kind ; and therefore, is most-ly applied to common purposes. It is performed by cementing the gold to the ground, by means of fat oil. The preparation of which is, therefore previously necessary to be known ; and may be much better managed in the following manner, than by any method hitherto taught, or commonly practiced.——“ Take any quantity of linseed oil, and put it into an earthen, or any other vessel of a broad form, so that the oil may lie in it with a very large surface ; but the proportion should be so limited, that the oil may be about an inch thick in the vessel. The earthen pans used for milk, in the forming cream for butter, are very well accommodated to this purpose. Along with the oil as much water should be also put into the vessel, as will rise six inches or more above the bottom. Place the vessel then, with the oil swimming on the water, in any open place where the sun and rain may have access to it ; but where it may be as free from receiving dust and filth as possible. Let it stand in this condition, stirring the contents on every opportunity, for five or six weeks, or till it appear of the consistence of treacle. Take the oil then from off the water into a phial, or bottle of a long form, or what is better, into a separating funnel, such as is used by the chemists, and there draw off the remainder of the water. Place it afterwards, being in the long bottle or phial, in such heat as will render it perfectly fluid ; and the foulnesses it may contain will soon subside to the bottom ; when the

clear part must be poured off; and the remainder strained through a flannel, while yet water, and the whole will then be fit for use."——It is to be observed, that this method is only practicable in summer; as the sun has not sufficient power in winter to produce a due change in the oil. This method differs from that commonly practised, in the addition of the water; which suffers the foulness to separate from the oil, and sink to the bottom; where it remains without being again mixed with the oil every time it is stirred, as is unavoidable where no water is used. The water likewise greatly contributes to bleach the oil, and improve it in other respects. The best previous preparation of the piece to be gilded, if it have not already any coat of oil paint, is to prime it with drying oil mixed with a little yellow ochre; to which, also, a very small proportion of vermillion may be added. But where greater nicety and perfection is required in the work, the wood should be first rubbed with fish skin; and then with Dutch rushes. This priming being dry, the next part of the operation is the sizing the work; which may be done, either with the fat oil alone, (but diluted with drying oil, if too thick to be worked without) or with fat oil, and the japanner's gold size, (of which the preparation, is below taught) either in equal quantities, or in any less proportion, with respect to the gold size. The difference betwixt the use and omission of the gold size, in this way of gilding, lies in two particulars. The one is, that the sizing dries faster according to the proportion of the quantity of the gold size to the fat oil, and is consequently so much the sooner fit to be gilded. The other is, that the gilding is also rendered, in the same proportion, less shining and glossy; which is esteemed a perfection in this kind of gilding: though, taking away the prejudice of fashion, I should think the most shining the most beautiful; and of the strongest effect. The fat oil, or the compound of that and the gold size, must be ground with some yellow ochre; and then by means of a brush, laid thinly over the work to be gilt. But, in doing this, care must be



taken to pass the brush into all the hollows and cavities, if the subject be carved, or have any other way, projecting parts. For where the size fails to be laid on, the gold will never take till the work be again repaired, by going over the defective places with fresh size : which should be avoided as much as possible. Where great perfection is required, the gold should not be laid on the first sizing ; but that being suffered to dry, the work should be again sized a second time : and some who are very nice even proceed to a third. The work being thus sized, must be kept till it appear in a proper condition to receive the gold : which must be distinguished by touching with the finger. If it appear then a little adhesive or clammy, but not so as to be brought off by the finger, it is in a fit condition to be gilt. But if it be so clammy as to daub or come off on being touched, it is not sufficiently dry, and must be kept longer : or if there be no clamminess or sticky quality remaining, it is too dry, and must be sized over again before it can be gilt. When the work is thus ready to receive the gold, the leaves of gold, where the surface is sufficiently large and plain to contain them, may be laid on entire, either by means of the squirrel's tail ; or immediately from the paper in which they were originally put ; a method, that, by those who have the proper dexterity of doing it, is found to be much the simplest and quickest, as well as best, for the perfection of the work. Being laid on the proper parts of the work, the leaves must then be settled to the ground, by compressing those, which appear to want it, gently with the squirrel's tail or cotton ball ; and if any part of the gold has flown off, or been displaced, so as to leave a naked or uncovered spot, a piece of another leaf, of size and figure correspondent to such spot, must be laid upon it. Where the parts are too small to admit of the laying on whole leaves, or where vacancies are left after laying on whole leaves which are less than require others to cover them, the leaves which are to be used must be first turned from the paper upon the cushion (described above amongst the instruments). They must then be cut, by scoring over them, with the knife



(above described likewise) into such divisions or slips as may be most commodiously laid on the parts of the work to be covered. After which being separated, and taken up as they are wanted by means of the cotton wool, to which being breathed upon they will adhere, they must be laid in the places they are designed to cover; and gently pressed by the cotton, till they touch every where, and lie even on the ground. Where the work is very hollow, and small pieces are wanted to cover parts that lie deep and out of the reach of the squirrel's tail or the cotton, they may be taken up by the point of a fitch pencil (being first breathed upon) and by that means conveyed to and settled in their proper place. Those who are accustomed to it, use the pencil commodiously for a great part of the work where large parts of the leaves cannot be used. The whole of the work being thus covered, should be suffered to remain till it be dry; and it may then be brushed over by a camel's hair pencil or soft hog's hair brush, to take off from it all loose parts of the gold. If, after the brushing, any defective parts, or vacancies appear in the gilding, such parts must be again sized; and treated in the same manner as the whole was before: but the japanner's gold size alone is much better for this purpose than either the fat oil alone, or any mixture.

*Of burnish gilding; with the preparation of the proper sizes, &c.*] The gilding with burnished gold is seldom practised, but upon wood; and at present mostly in the case of carved work, or where carved work is mixed with plain. The chief difference in the manner betwixt this and old gilding lies in the preparing the work to receive the gold; and in the substituting a size made of parchment, or the cutting of glover's leather in the place of the fat oil, as a cement. The preparation of this size should, therefore, be previously known; and may be as follows.—“Take a pound of the cuttings of parchment, or of the leather used by glovers; and, having added to them six quarts of water, boil them till the quantity of fluid be reduced to two quarts: or

till, on the taking out a little, it will appear like a jelly on growing cold. Strain it through flannel while hot ; and it will then be fit for use." — This size is employed in burnish gilding, not only in forming the gold size, or cement for binding the gold to the ground ; but also in priming, or previously preparing the work. But before I proceed to show the manner of using it so, it is necessary to give the compositions for the proper cement or gilding size employed in this kind of gilding. There are a multiplicity of recipes for this composition, which are approved of by different persons : but as in general they vary not essentially from each other, I will only give two, which I believe to be each the best in their kinds. — " Take any quantity of bole armoniac, and add some water to it, that it may soak till it grow soft. Levigate it then on the stone, but not with more water than will prevent its being of a stiff consistence ; and add to it a little purified suet or tallow scraped ; and grind them together. When this is wanted for use, dilute it to the consistence of cream, by parchment or glover's size, mix'd with double its quantity of water, and made warm. Some melt the suet or tallow, and mix it previously with five or six times its weight of chalk before it is put to the bole, to facilitate their commixture ; to which in this wet state they are otherwise somewhat repugnant. It is also sometimes practised to put soap suds to the bole ; which will contribute to its uniting with the tallow. — This is the simplest composition, and equally good with the following, or any other ; but for the indulgence of the variety of opinions, which reigns in all these kinds of matters, I will insert another. " Take of bole in fine powder one pound, and of black lead two ounces. Mix them well by grinding ; and then add of olive oil two ounces, and of bees-wax one ounce melted together ; and repeat the grinding till the whole be thoroughly incorporated. When this mixture is to be used, dilute it with the parchment or glover's size, as was directed in the former recipe. But till the time of using them, both this and the foregoing should be kept

immersed in water, which will preserve them good.”  
 — To prepare the wood for burnish gilding, it should first be well rubbed with fish-skin; and then with Dutch rushes: but this can only be practised in the larger and plainer parts of the work, otherwise it may damage the carving, or render it less sharp by wearing off the points. It must then be primed with the glover’s size, mixed with as much whiting as will give it a tolerable body of colour: which mixture must be made by melting the size, and strewing the whiting in a powdered state gradually into it, stirring them well together, that they may be thoroughly incorporated. Of this priming seven or eight coats should be given, time being allowed for the drying of each before the other part be put on: and care should be taken in doing this, to work the priming well with the brush, into all the cavities or hollows there may be in the carved work. After the last coat is laid on, and before it be quite dry, a brush pencil dipt in water should be passed over the whole, to smooth it and take away any lumps or inequalities that may have been formed: and when it is dry, the parts which admit of it should be again brushed over till they be perfectly even. The work should then be repaired, by freeing all the cavities and hollow parts from the priming, which may choak them, or injure the relief of the carving: after which a water polish should be given to the parts designed to be burnished, by rubbing them gently with a fine linen rag moistened with water. The work being thus prepared, when it is to be gilt, dilute the composition of bole, &c. with warm size mix’d with two-thirds of water; and with a brush spread it over the whole of the work, and then suffer it to dry; and go over it again with the mixture, in the same manner, at least once more. After the last coat, rub it in the parts to be burnished with a soft cloth, till it be perfectly even. Some add a little vermilion to the gilding size, and others colour the work, if carved, before it be laid on, with yellow and the glover’s size; to which a little vermilion, or red lead, should be added. This last method is to give the appearance

of gilding to the deeper and obscure parts of the carving, where the gold cannot, or is not thought necessary to be laid on. But this practice is at present much disused; and instead of it such parts of the work are coloured after the gilding; which treatment is called *matting*. The work being thus properly prepared, set it in a position almost perpendicular, but declining a little from you: and having the gilding size, place all the necessary instruments above described ready, as also a basin of clean water ready at hand: wet then the uppermost part of the work, by means of a large camel's hair pencil dipped in the water; and then lay on the gold upon the part so wet, in the manner above directed for the gilding in oil, till it be completely covered, or become too dry to take the gold. Proceed afterwards to wet the next part of the work, or the same over again if necessary, and gild it as the first; repeating the same method till the whole be finished. Some wet the work with brandy, or spirit of wine, instead of water; but I do not conceive any advantage can arise from it, that may not be equally obtained by a judicious use of water. This manner is moreover much more troublesome and difficult, as well as expensive. For only a small part must be wet at one time, and the gold laid instantly upon it, or the brandy or spirits will fly off, and leave the ground too dry to take the gold. The work being thus gone over with the gilding, must be then examined; and such parts as require it repaired, by wetting them with the camel's hair pencil, and covering them with the gold; but as little as possible of the perfect part of the gilding should be wet, as the gold is very apt to turn black in this state. When the repaired part also is dry, the work may be matted, if it require it; that is, the hollow parts must be covered with a colour the nearest in appearance to gold. For this purpose some recommend red lead, with a little vermillion ground up with the white of an egg: but I think yellow oker, or Dutch pink, with red lead, would better answer the end: or the *terra di Sienna* very slightly burnt or mixed with a little red lead

would have a much better effect ; and be more durable than any other mixture so near the colour of gold in shade. Ifinglass size will likewise equally well supply the place of the whites of eggs in the composition for matting. The work being thus gilt, it must remain about twenty four hours ; and then the parts of it that are designed to be burnished, must be polished with the dog's tooth, or with the burnishers of agate or flint made for this purpose. But it should be previously tried, whether it be of the proper temper as to dryness. For though twenty-four hours be the most general space of time, in which it becomes fit, yet the difference of season, or the degree of wet given to the work, makes the drying irregular, with regard to any fixed period. The way of distinguishing the fitness of the work to take the burnish, is to try two or three particular parts at a distance from each other ; which, if they take the polish in a kindly manner, the whole may be concluded fit. But if the gold peel off, or be disordered by the rubbing, the work must be deemed not yet dry enough : and if the gold abide well the rubbing, and yet receives the polish slowly, it is a proof of its being too dry : which should be always prevented, by watching the proper time. For the work, when too dry, both requires much more labour to burnish it, and fails at last of taking so fine a polish.

*Of japanners gilding.*] The japanners gilding is performed by means of gold powder, or imitations of it, cemented to the ground by a kind of gold size much of the nature of drying oil : for the making which, there are various recipes followed by different persons. I shall, however, only give one of the more compound, that is much approved ; and another very simple, but which, nevertheless, is equally good for the purpose with the most elaborate. The more compound gold size may be thus made.—“ Take of gum animi and asphaltum each one ounce, of read lead, litharge of gold and umbre, each one ounce and a half. Reduce the grosser ingredients to a fine powder ; and having mix'd them, put them, together with a pound of linseed oil, into a pro-



per vessel, and boil them gently; constantly stirring them, with a stick or tobacco-pipe, till the whole appear to be incorporated. Continue the boiling, frequently stirring them, till, on taking out a small quantity, it appear thick like tar, as it grows cold. Strain the mixture then through flannel; and keep it carefully stopp'd up in a bottle having a wide mouth, for use. But when it is wanted, it must be ground with as much vermillion, as will give it an opaque body; and at the same time diluted with oil of turpentine, so as to render it of a consistence proper for working freely with the pencil."

—The asphaltum does not, I conceive, contribute to the intention of gold size: and the litharge of gold and read lead, are both the same thing, with respect to this purpose, under different names: and neither they nor the umbre necessary, but clogging ingredients to the composition. This gold size may therefore be equally well, or perhaps better prepared, in the following manner—"Take of linseed oil one pound, and of gum animi four ounces. Set the oil to boil in a proper vessel; and then add the gum animi gradually in powder; stirring each quantity about in the oil, till it appear to be dissolved; and then putting in another, till the whole become mixed with the oil. Let the mixture continue to boil, till on taking a small quantity out, it appear of a thicker consistence than tar: and then strain the whole thro' a coarse cloth, and keep it for use. But it must, when applied, be mixed with vermillion and oil of turpentine, in the manner directed for the foregoing."—This gold size may be used on metals, wood, or any other ground whatever. But before I enter on the particular manner of gilding with it, the preparation of the true and counterfeit gold powders are necessary to be shown. The true gold powder may be well and easily made by the following method.—

"Take any quantity of leaf gold; and grind it with virgin honey, on a stone, till the texture of the leaves be perfectly broken; and their parts divided to the minutest degree. Then take the mixture of gold and honey from off the stone, and put it into a china or other

such bafon, with water; and flir it well about, that the honey may be melted; and the gold by that means freed from it. Let the bafon afterwards fland at reft, till the gold be fubfided; and when it is fo, pour off the water from it; and add frefh quantities till the honey be entirely washed away; after which the gold may be put on paper, and dried for ufe.”—A gold powder of a more intenfè yellow colour, brighter than this, may be made by a precipitation from gold diffolved in *aqua regia*, by means of either green or Roman vitriol, in this manner. —“Take a folution of gold in *aqua regia*; and add to it gradually, a folution of green vitriol or copperas in water, till it appear that no further precipitation of the gold be made, on adding a frefh quantity. The folution of the copperas may be made, by putting one diachm of it powdered into an ounce of water, and flaking them till the whole appear to be diffolved. After which the folution muft fland; and the clear part be poured off from the fediiment, if any be found. The fluid muft be poured off from the precipitated gold, as foon as it is perfectly fubfided; and the precipitation muft be well washed, by pouring on it feveral fucceffive quantities of water. Roman or blue vitriol may be employed for this purpofe inftead of the green, but it is fomewhat dearer, and has no advantage over the other. The gold precipitate thus obtained is very bright and flining. A fimilar kind may be prepared, by putting flat bars or plates of copper into the folution of the gold in *aqua regia*: but the precipitate is of a brown colour, without any luftre or flining appearance.”—The German gold powder, which is the kind moft generally ufed, and, where it is well fecured with varnifh, will equally answer the end in this kind of gilding with the genuine, may be prepared from the fort of leaf gold, called the *Dutch gold*, exactly in the fame manner as the true. The *aurum Mofaicum*, which is tin coloured, and rendered of a flafky or pulverine texture, by a chemical procefs, fo as greatly to refemble gold powder, may be likewife ufed in this kind of gilding; and prepared in



the following manner—"Take of tin one pound, of flowers of sulphur seven ounces, and of *sal Ammoniacus* and purified quicksilver each half a pound. Melt the tin; and add the quicksilver to it in that state: and when the mixture is become cold, powder it, and grind it with the *sal Ammoniacus* and sulphur, till the whole be thoroughly commixt. Calcine them then in a matraass; and the other ingredients subliming, the tin will be converted into the *aurum Mosaicum*; and will be found in the bottom of the glass like a mass of bright flaky gold powder: but if any black or discoloured parts appear in it, they must be carefully pick'd or cut out."—The *sal Ammoniacus* employed ought to be perfectly white and clean; and care should be taken that the quicksilver be not such as is unadulterate with lead; which may be known, by putting a small quantity in a crucible into the fire, and observing, when it is taken out, whether it be wholly sublimed away, or have left any lead behind it. The calcination may be best performed in a coated glass body, hung in the naked fire; and the body should be of a long figure, that the other ingredients may rise so as to leave the coloured tin clear of them. The quicksilver, tho' it be formed into cinnabar along with the sulphur, need not be wasted; but may be revived by distilling it with the addition of quick-lime; for which a very cheap and commodious method and apparatus may be found in a late treatise on practical chemistry, intitled, *The Laboratory laid open*. &c. There are some other coarser powders in imitation of gold, which are formed of precipitations of copper. But as they are seldom used now for gilding, I shall defer showing the manner of preparing them, till I come to speak of bronzing, where they more properly occur. Besides these powders, the genuine leaf or Dutch gold may be used with the japanners gold size, where a more shining and glossy effect is desired in the gilding. But in that kind of gilding which is intended to be varnished over, or to be mixed with other japan work or paintings in varnish, the powders are most frequently employed. The gilding with japanners gold

size may be practised on almost any substance whatever, whether wood, metal, leather, or paper : and there is no further preparation of the work necessary to its being gilt, than the having the surface even and perfectly clean. The manner of using the jappanners size, is this. Put then a proper quantity of it, prepared as above directed, and mixed with the due proportion of oil of turpentine and vermillion, into a small gally-pot, or one of those tin vessels above described, for containing the colours when used for in painting varnish. Then either spread it with a brush over the work, where the whole surface is to be gilt ; or draw with it, by means of a pencil, the proper figure desired, avoiding carefully to let it touch any other parts. Suffer it afterwards to rest till it be fit to receive the gold : which must be distinguished by the finger, in the same manner as with the fat oil ; the having a proper clamminess or sticky quality, without being so fluid as to take to the finger, being alike the criteriton in both cases. Being found of a proper dryness, when the gold powders are to be used, a piece of the soft leather, called *washleather*, wrapt round the fore finger, must be dipt in the powder, and then rubbed very lightly over the sized work ; or, what is much better, the powder may be spread by a soft camel's hair pencil. The whole being covered, it must be left to dry ; and the loose powder may then be cleared away from the gilded part, and collected, by means of a soft camel's hair brush. When leaf gold is used, the method of sizing must be the same as for the powders : but the point of due dryness is very nice and delicate in these cases. For the leaves must be laid on while the matter is in a due state, otherwise the whole of what is done must be sized and gilt over again. When more gold size is mixed up with the oil of turpentine and vermillion, than can be used at one time, it may be kept, by immersing it under water till it be again wanted : which is indeed a general method of preserving all kind of paint, or other such compositions as contain oily substances.

[Of gilding paper, vellum or parchment.] There are

a variety of methods used for gilding paper, according to the several ends it is designed to answer; but for the most part size, properly so called, and gum water, are used as the cements; and the powders are more generally employed than the leaf gold. As I have given the preparation of these several substances before, it is needless to repeat them here; and I shall therefore only point out those circumstances in the manner of their use, which are peculiar to the application of them to this purpose.

*Of the gildings on paper proper to be used along with paintings in water colours, or fresco.]* The gilding proper to be used with water colours may be either with the leaf gold, or powder; which last, when mixed with the proper vehicle, is called *shell gold*. The leaf gold is necessary in all cases, where a metalline and shining appearance is wanted: and it may be laid on the designed ground, by means either of gum water, or isinglass size. The gum water or size should be of the weaker kind, and not laid too freely on the ground; and proper time should likewise be given for it to dry: the judgment on which must be formed, in this case, as in the other kinds of gilding, by touching with the finger. The management of the gold also is much the same in this as in the former: and where a polished appearance is wanting, the dog's tooth or other kind of burnisher may be used. In the gilding larger surfaces, it will be found advantageous to colour the ground with the gall stone: and where colours are to be laid on the gilding, the brushing the gold over with the gall of any beast will make it take them in a much more kindly manner. When the gold powders are used along with paintings in water colours, it is previously formed into *shell gold*, (as it is called, from its being usually put into muscle shells, in the same manner as the colours.) This shell gold is prepared, by tempering the gold powder with very weak gum water; to which a little soap-suds may be put, to make the gold work more easily and freely. The preparation of the gold powders is before given, p. 12, and that of the gum

water, may be thus prepared.—“Take three quarters of an ounce of gum Arabic, and a quarter of an ounce of gum Senegal. Powder them, and then tie them up in a linen rag; leaving so much unfilled room in the bag, as to admit its being flattened by the pressure of the hand. Having squeezed the bag till it be flat, put it into a quart of hot water; and there let it continue, moving it sometimes about, and stirring the water for about twenty-four hours. The gums will then be dissolved; and the bag must be taken out. The fluid being divided into two parts, to one half of it add a quarter of an ounce of white sugar-candy powdered, and keep the other in its pure state. By this means, a strong and weak gum water, each proper for their particular purposes, will be obtained.”

*Of the gilding proper for the coloured paper for binding books, and other such purposes.]* This kind of gilding is performed in much the same manner as that for mixing with paintings in water colours; except with regard to the following particulars. First, in this case, the gilding being intended generally to form some figure or design, the gum water or size, instead of being laid on with a brush or pencil, is most generally conveyed to the ground by means of a wooden plate, or print, and most expediently by an engraved roller, which make an impression of the figure or design intended. Secondly, as the rising of the gold from the surface of the ground is no disadvantage in this kind of gilding, as it is in that mixed with paintings, the gum water or size may be much stronger; which will contribute both to bind the gold firmer, and to give it a sort of embossed appearance, that improves the effect. In this kind of gilding, the japanners gold size may be also commodiously employed. For, as the paper must be moistened before it be printed, there is no inconvenience liable to happen from the running of the gold size thus used. Where the embossed appearance is wanted in the greatest degree, the gold size should indeed always be used: and in this case should be thickened with yellow oker, mixed with as much red lead, as the proper working

of the print will admit. The wooden plates or prints used for gilding in this manner, are worked by the hand, and are to be charged with the gum water or size, of whatever kind it be, by letting it gently and evenly down on a cushion on which the gum water or size has been copiously spread by means of a proper brush; and then pressing it on the paper prepared by moistening it with water, and laid horizontally with some sheets of other paper under it. Where the rolling print is employed, the gum water or size must be laid on it by a proper brush, immediately out of the pot or vessel which contains it: but too copious an use must be avoided, for fear of spreading it beyond the lines of the design or pattern. The subsequent management of the gold, whether leaf or powder, must be the same as in the foregoing kinds of gilding. It rarely answers to use the leaf gold in this kind of painting, nor even the true gold powder: but the German powder, or that formed of the leaves called *Dutch gold*, is mostly employed, and answers well enough the purpose. The manufactures of the gilt and marbled papers have not been so much cultivated in our own country, as it were to be wished, since very great sums have been always annually paid, both to Germany and Genoa, on this account. The improvement of this manufacture is, therefore, a very fit object of attention to that most laudable society for the establishment and encouragement of useful arts, who have offered premiums to those who would give proofs of their endeavours or success in parallel instances. This society has accordingly given lately a bounty to Mr. Moor, of New-street, who has established a manufacture of gilt and flowered paper; which exceeds greatly the foreign in beauty, and is sold at a cheaper rate than that can be afforded, even when the duty on importation is not paid.

[*Of gilding proper for letters of gold on paper, and the embellishment of manuscripts.*] The most easy and neat method of forming letters of gold on paper, and for ornaments of writings, is, by the *gold ammoniac*, as it was formerly called: the method of managing which is



s follows.—“Take gum Ammoniacum, and powder it, and then dissolve it in water previously impregnated with a little gum Arabic, and some juice of garlic. The gum Ammoniacum will not dissolve in water, so as to form a transparent fluid, but produces a milky appearance; from whence the mixture is called in medicine the *lac Ammoniacum*. With the lac Ammoniacum thus prepared, draw with a pencil, or write with a pen on paper, or vellum, the intended figure or letters of the gilding. Suffer the paper to dry; and then, or any time afterwards, breathe on it till it be moistened; and immediately lay leaves of gold, or parts of leaves cut in the most advantageous manner to save the gold, over the parts drawn or written upon with the lac Ammoniacum; and press them gently to the paper with a ball of cotton or soft leather. When the paper becomes dry, which a short time or gentle heat will soon effect, brush off, with a soft pencil, or rub off by a fine linen rag, the redundant gold which covered the parts between the lines of the drawing or writing; and the finest hair strokes of the pencil or pen, as well as the broader, will appear perfectly gilt.”—It is usual to see in old manuscripts, that are highly ornamented, letters of gold which rise considerably from the surface of the paper or parchment containing them, in the manner of embossed work; and of these some are less shining, and others have a very high polish. The method of producing these letters is of two kinds; the one by friction on a proper body with a solid piece of gold: the other by leaf gold. The method of making these letters by means of solid gold is as follows.—“Take crystal, and reduce it to powder. Temper it then with strong gum water, till it be of the consistence of paste; and with this, form the letters. When they are dry, rub them with a piece of gold of good colour, as in the manner of polishing; and the letters will appear as if gilt with burnished gold.”—Kunckel has, in his fifty curious experiments, given this recipe: but omitted to take the least notice of the manner how these letters are to be formed; though the most difficult circumstance in

the production of them. It may, however, be done by means of a stamp in this manner. Let the embossed figure, either of the separate letters or of the whole words be cut in steel; and, when the stamps are to be used, anoint each letter carefully with the end of a large feather dipped in oil; but not so wet as to leave drops in the hollows of the stamps. Fill these concave letters, in the stamps, with the above mixture of powdered crystal and gum water; and, wiping the other parts of them perfectly clean, place them then on the paper or vellum, laid over some sheets of paper; taking care that the letters may be in the exact position where they ought to lie: strike then the stamp in a perpendicular direction, but not too forcibly; and take it off in the same direction. The letters will be left in their proper places by this means, and will have the same proportions as their archetypes in the stamps. Where leaf gold is used for making embossed letters in manuscripts, the above composition cannot be used; but there are several others which will very well supply its place: of which the following has been given as very excellent.—“Take the whites of eggs, and beat them to an oily consistence; then take as much vermilion as will be required to thicken the whites of the eggs to the consistence of paste. Form the letters of this paste, by means of the stamps, in the manner before directed; and when they are become dry, moisten them by a small pencil with strong gum water; observing not to let it run beyond the bounds of the letters. When the gum water is of a proper dryness, which must be judged of by the rule before given, cover the letters with leaf gold, and press it close to every part of them, by cotton or soft leather. After the gilding is dry, it may be polished by the dog’s tooth, or the other proper burnishers.”

*Of gilding proper for the edges of books and paper.]*  
There are several various methods with respect to the cement used, by which the edges of books or paper may be gilt: as strong gum water, or isinglass size, or glovers size, may be employed: but as the gum water, and weaker sizes are apt to run beyond the edge, and



stick the leaves together, ifinglass melted with the addition of some common proof spirit of wine, and a sixth part of honey or sugar candy is greatly preferable : but a third of bole ammoniac well powdered must be added. The following composition has been likewise approved of for this purpose. —“Take bole ammoniac and sugar candy well powdered, each equal parts : mix them with the whites of eggs beaten to an oily consistence ; and the cement will be fit for use.”—In order to the using any of these cements, the paper, whether it be in quires or books, should be well cut, and polished on the edges to be gilt ; and then strongly screwed down by a press : in which state, it is to be brushed over ; first with a little of the cement without the sugar-candy or the bole ; and when that is dry, either with the cement above given, or any other solution of gum or size, with the proper proportion of the bole : after which it may be suffered to dry ; and then water polished, by rubbing it with a fine linen rag slightly moistened. It is then in a state fit for receiving the gold ; only it must be again gently moistened at that time : and the leaves may then be laid on, being cut according to the breadth they are to cover, and pressed closely down by a cotton ball : and after the gilding is thoroughly dry and firm, it may be polished in the manner of the foregoing kinds.

*Of gilding leather.*] Leather may be gilded for common occasions by all the same methods which have been given for gilding paper or velum ; except, that where the gold size is used, there is no occasion to wet the leather, to prevent the running of the oil out of the bounds. Either leaf gold or the powders may therefore be employed as well for leather as paper. But, unless, in some fine work, or for very particular purposes, the German gold powder would answer as well as the true gold. It is needless consequently to repeat here the methods above shown with respect to the gilding paper for covers to books, &c. which equally well suit for this purpose in general : but as there is a manner of gilding leather peculiar to the book-binders,

it is requisite to explain it. The method of gilding used by the book-binder, is to have the letters or compartments, scrolls, or other ornaments, cut in steel stamps; not by sinking, as in most other cases, but by the projection of the figure from the ground. These stamps are made hot; and leaves of gold being laid on the parts accommodated to the pattern or design of the gilding, the hot stamps are pressed strongly on the gold and leather; and bind the gold to it in the hollows formed by the stamp: the other redundant part of the gold being afterwards brushed or rubbed off. The manner practised by the professed leather gilders, for the making hangings for rooms, screens, &c. is not properly *gilding*, but *laquering*, being done by means of leaf silver, coloured by a yellow varnish, on the same principle with the laquered frames of pictures, &c. which were formerly in use. It is an important manufacture, as the leather ornamented in this manner, not only admits of great variety of designs in embossed work, resembling either gilding or silver; but also of the addition of paintings of almost every sort. The manner of performing this kind of leather gilding is as follows. The skins are first procured in a dry state, after the common dressing and tanning. Those most proper for this purpose, are such as are of a firm close texture; on which account, calf, or goat skins are preferable to sheep. But in that condition they are too hard and stiff for gilding in this way. In order therefore to soften them, they are first put for some hours in a tub of water, where they are, during such time, to be frequently stirred about with a strong stick. They are then taken out; and, being held by one corner, beaten against a flat stone. They are next made smooth, by spreading them on the stone, and rubbing them strongly over by an iron instrument resembling a blade, but with the lower edge formed round, and the upper edge set in a wooden handle, passing horizontally the whole length of the blade. This instrument the workman slides on the surface of the skin as it lies on the stone, at the same time pressing and lean-

g on it with all his weight. When one of the skins finished, another is laid over it, and treated in the same manner ; and the others over that. The skins being thus prepared, are joined together, to form pieces of the size required for any particular purpose. In order to their joining properly, they are cut into a square, or rather oblong square form. To which end, a ruler or square is used, or the skins are placed on a table or block, corresponding in size and figure to a wooden print of the kind we shall have occasion to speak of below, and as much of the skin is taken off, as leaves it of the form and dimensions of the table or block. Any defective parts, or holes in the skin, are then to be made good ; which is done by paring away with a pen-knife, half the thickness of the skin for some little space round the hole, or defective part ; putting a patch, or correspondent piece of the same kind of skin over it. This patch, or piece, is to have a margin pared to have the thickness, to suit the pared part of the skin ; and is then to be fixed in its place, by means of a size made of parchment, or gloves cuttings, in the manner described before. After the skins are thus prepared, the next operation is the sizing them, which is done by means of a kind of soft glue, or stiff size, that answers to the gold size, used in other kinds of gilding or silvering, prepared from parchment, or gloves cuttings. This is, in fact, the same with that directed to be used for joining the pieces ; only it must be reduced by longer boiling to a thicker consistence, which should be that of a very stiff jelly. To size a skin or piece, the workman takes a piece of the size of the bigness of a nut ; which, however, he does not use whole, but cuts into two parts. With one of these parts, he rubs all the skin, or piece of leather, strongly ; and when it is, by this means, spread over the whole surface of the leather, he rubs it with the palm of his hand to disperse it more equally, and uniformly over every part. To the effecting this end, the heat of the hand contributes as well as the motion : as it melts the size to a certain degree of fluidity, and ren-

ders it consequently more capable of being diffused over the whole surface. The workman then leaves the skin for some time to dry, and afterwards spreads the other part of the size on it, in the same manner as the first; which finishes the operation of sizing. It is necessary to allow some space of time betwixt the laying on the two parts of the size. For if the whole was laid on together; or the first part before the other was dry to a certain degree, the whole would dissolve, and be forced forwards before the hand, instead of being spread by it. In the prosecution of this business, the workman therefore, as soon as he has spread the first part of the size, takes another skin, and treats it in the same manner: which filling up the interval of time, proper for drying the first, he returns then to that, and puts on the other parts of the size, and by this alternative treatment of them, employs the whole of his time, without any loss, by waiting till either be dry. The side of the skin on which the hair grew, or what is called the *grain* of the leather, is always chosen for receiving the size and silver. This is necessary to be observed: because that side is even, and of a closer texture than the other. The skins, being thus sized, are ready for receiving the leaves of silver: which are thus laid on. The workman, who silvers them, stands before a table; on which he spreads two skins before they are dry after the sizing. On the same table, on the right hand, he puts also a large book of leaf silver on a board, which near one end of it has a peg sufficiently long to raise it in such manner, as to make it slope like a writing desk. The book being thus placed, he takes out one by one the leaves of silver, and lays them on the skin previously sized as above. This he does by means of a small pair of pincers, formed by two little rods of wood fastened together at one end, and glued to a small piece of wood cut into the form of a triangle, intended to keep the ends of the two rods at a distance from each other; and to make them answer the purpose, when pressed by the fingers, of taking hold of the leaves of silver. On the side of the piece

in which the rods are joined to form the pincers, there is put a kind of tuft, or small brush, of an irregular form, made of foxes, or any other kind of soft hair. With these pincers, the workman takes hold of one of the leaves in the book, and puts it on a piece of cartoon, larger than the leaf, of a figure nearly square; and which has the corners of the end, that is to be placed in the hand of the workman, bent. This piece of cartoon is called a pallet. The workman takes it in his left hand, and, having put on it a leaf of silver, he turns it downward; and lets the leaf fall on the skin, spreading it as much as he can, and bringing, as near as possible, the sides of it, to be parallel to those of the square of leather, or skin. If it happen, that any part of it gets double, or is not duly spread, he sets it right; raises it sometimes, and puts it in its place, or rubs it gently with the kind of brush, or hair pencil which is at the end of the pincers. But most generally, the workman only lets the leaf fall in its place, spread out on the surface of the leather, without either touching or pressing it; except in the case we shall mention below. After he has done with this leaf, he lays a new one in the same line, and continues the same till such line be complete. He then begins close to the edge of this row of leaves, and forms another in the same manner; and goes on thus, till the whole skin be entirely covered with the leaf silver. This work is very easily and readily performed; as the leaves which are of a square form, are put on a plain surface, which is also rectangular. The skin being thus covered with the silver, the workman, takes a fox's tail, made into the form of a ball at the end, and uses it to settle the leaves, by pressing and striking them, to make them adhere to the size, and adopt themselves exactly to the places they are to cover. He afterwards rubs the whole surface gently with the tail, without striking, which is done to take off the loose and redundant parts of the silver, and at the same time to move them to those places of the surface, where there was before any defect of the



silver; and where, consequently, the size being bare, these will now take. The rest of the loose silver is brushed forwards to the end of the table, where a bag, or linen cloth is placed to receive it.

The skins, when they are thus silvered, are hung to dry on cords, fixed by the ends to opposite walls, at such height as to suspend the skins out of the way of the workman. To hang them on these cords, a kind of cross is used, formed of a strong stick, with a shorter piece of the same fixed crosswise at the end of it; over which the skin being hung without any doubling and with the silvered side outwards, it is conveyed and transferred to the cord in the same state. The skins are to dry in this condition, a longer or shorter time, according to the season and the weather. In summer, four or five hours is sufficient; or those skins which have been silvered in the morning, may remain till the evening, and those in the evening, till next morning. But in winter a longer time is required, according to the state of the weather. There is no occasion, nevertheless, to wait till they be entirely dry. As they may be put in any back yard or garden exposed to the wind, and the heat of the sun. For this purpose they should be put over two boards joined together, where they must be kept stretched out by means of some nails. But in this case, the silvered side must be next the boards, in order to prevent any dirt from falling on it, and sticking to the size, which would hinder their taking well the burnish, that will be mentioned below. The heat, and the dryness of the air, must determine, also, the time of their hanging in this state: but experience alone can teach how to judge of this point. It is proper the skin should be free from moisture; but yet, they should retain all their softness: in summer this will happen in a few hours, and they will be then in a condition to be burnished. The burnisher which is used for this purpose, is a flint, of which various figures may be allowed, and which must be mounted differently with a handle, according to the difference of the figure. A cylindrical form is often chosen, in which case, one

of the ends should be of a round figure, of about an inch and a half diameter, and have the surface extremely smooth ; as the polishing is performed with this surface. The flint is fixed in the middle of a piece of wood of a foot length, the whole of which length is necessary to its serving as a handle ; or the workman takes hold of it at each end, with each of his hands, those parts being roundish, and the middle being left of a greater thickness, in order to admit of a hole of a proper depth for receiving the flint, so as to keep it quite firm and steady. All the art required in the manner of burnishing is, to rub the leaf silver strongly ; for which purpose, the workman applies both hands to the burnisher, dwelling longer on those parts which appear most dull. In order to perform this operation, the skin is put and spread even on a smooth stone of a requisite size, placed on a table, where it may be so firm and steady, as to bear all the force of pressure the workman can give in sliding the burnisher backwards and forwards over every part of the skin. It would save a great deal of labour to employ, instead of this method of burnishing, that used by the polishers of glass, and also by the card makers. This method consists in fixing the burnisher at the end of a strong crooked stick, of which, the other end is fastened to the ceiling. The stick being so disposed, as to act as a spring, of which the force bears on the skin, it exempts the workman from this part of the labour, and leaves him only that of sliding the burnishers along the skin, in the directions the polishing requires. The objections to this method are, that some parts of the skin require a greater pressure than others, and that sometimes dirt sticking to the size, which passes through the joining of the silver, will scratch the work, if the workman in going along did not see and remove it, which he cannot so well do in using the spring burnisher. But certainly, these inconveniencies have obvious remedies, when they are understood. The using the spring burnisher for the greatest part of the work, does not prevent taking the aid of the common one for

finishing, if any parts, that appear imperfectly polished, shall render it necessary; and the workman may well afford the trouble of examining the skin, and cleansing it thoroughly, by the labour he will save in this way; or, perhaps, it is always best to do this office, before any kind of polishing be begun, rather than to leave it to be done during the polishing. In some manufactures, the burnishing is performed, by passing the silvered skins betwixt two cylindrical rollers of steel, with polished faces. If this be well executed, it must give a considerable brilliancy to the silver, and take away all those warpings and inequalities in the leather, which tend to render the silvered surface less equal and shining. The skins or leather, being thus silvered and burnished, are now prepared to receive the yellow laquer or varnish, which gives the appearance of gilding. The perfection of this work depends, obviously, in a great degree, on the colour, and other qualities of the composition used as such varnish: for which different artists in this way have different recipes; each pretending, in general, that his own is best, and making consequently a secret of it. The following is, however, at least equal to any hitherto used; and may be prepared without any difficulty, except some little nicety in the boiling.—“Take of fine white resin four pounds and a half; of common resin the same quantity; of gum sandarac two pounds and a half, and of aloes two pounds. Mix them together, after having bruised those which are in great pieces; and put them into an earthen pot, over a good fire made of charcoal, or over any other fire where there is no flame. Melt all the ingredients in this manner, stirring them well with a spatula, that they may be thoroughly mixed together, and be prevented also from sticking to the bottom of the pot. When they are perfectly melted and mixed, add gradually to them, seven pints of linseed oil, and stir the whole well together with the spatula. Make the whole boil, stirring it all the time, to prevent a kind of sediment, that will form, from sticking to the bottom of the vessel. When the var-

nish is almost sufficiently boiled, add gradually, half an ounce of litharge, or half an ounce of read lead ; and when they are dissolved, pass the varnish through a linen cloth, or flannel bag."

The time of boiling such a quantity of varnish, may be in general about seven or eight hours. But as the force of the heat, and other circumstances, may vary, it does not permit of any precise rule. The means of judging of this, is by taking a little quantity out of the pot, with a silver spoon, or other such instrument, and touching it with the finger ; when, if the varnish appear, on cooling, of the consistence of a thick syrup, become soon after ropy, and then drying, glue the fingers together, and give a shining appearance ; it may be concluded, the time of boiling is sufficient. But if these signs are found wanting, the contrary must be inferred ; and the boiling must be continued till they do arise. When the quantity of ingredients is diminished, the time of boiling may be also contracted. A pint of oil, and a correspondent proportion of fine resin and aloes, has produced a varnish perfectly good in an hour and a half. In this process, it is very necessary to have a pot, that will not be half filled with all the ingredients ; and also to guard with the greatest caution against any flame coming near the top of the pot, or the vapour, which rises from it during the boiling. For it is of so combustible a nature, it would immediately take fire ; and the ingredients themselves would burn in such a manner, as would not only defeat the operation, but occasion the hazard of other inconveniencies. The varnish thus prepared, attains a brown appearance ; but, when spread on silver, gives it a colour greatly similar to that of gold. If, however, it should not be found, after this proceeding, that the force of yellow was sufficiently strong, an addition of more aloes must be made before the boiling be discontinued. Care must be taken, nevertheless, in doing this, not to throw in a large lump at once ; because such an effervescence is excited, in that case, as would endanger the varnish rising over the edge of the

vessel, and producing a flame, that would instantly make the whole take fire. On the other hand, if the varnish seem too strong of the colour, sandaric must be added with the same precaution, which increasing the quantity of varnish, will dilute the colour. The laying the laquer, or varnish on the silvered leather, is performed in the open air : and should be done in summer, when it is hot and dry. It is thus performed : The skins are again to be stretched and fastened with nails to the same boards on which they were before fixed to complete the drying after the silvering : but with this difference, that the silvered side must be outwards. Eighty or twenty skins may be treated thus at the same time : there being two or three on each board. All the boards should be then ranged on tressels parallel to each other, in such manner, that all, both of them and the skins, may be close to each other. Every thing being thus prepared, the principal workman spreads some of the white of eggs over each skin. The use of this is to fill up small inequalities in the surface of the skin ; and to prevent the varnish passing through the interstices of the silver, and being absorbed by the leather. Some omit this : and with advantage, if these inconveniencies could be avoided without it : as it renders the varnish more apt to crack and peel off the silver. But where it is omitted, the varnish should be of a thicker consistence ; the surface of the leather of a firm dense texture ; and the leaves of silver of a greater thickness than the common. When the white of eggs is dry, the workman who lays on the varnish sets it on the table before him in a pot ; being, as before directed, pretty near the consistence of a thick syrup. He then dips the four fingers of one of his hands in the varnish ; and uses them as a pencil to spread it on the skin. In doing this, he holds the fingers at a small but equal distance from each other, and putting the ends of them on the skin near one of the edges of it ; and he then moves his hands so, that each finger paints a kind of S with the varnish, from one end of the skin to the other. He afterwards dips his fingers again in the varnish, and repeats the same operation again on the



next part of the skin, till the whole be gone over in the same manner. This might be done with a pencil or proper brush : but the workman finds the using the fingers only, to be the readiest method for distributing the varnish equally over the skin. After the varnish is thus laid on the skin, it is to be spread : which is still done by the hand solely. The method is, to rub the flat of the open hand over every part of the skin on which the varnish has been put by the fingers, and by that means diffuse it evenly over every part. After this, it is to be immediately beaten by strokes of the palms of the hands, which are to be frequently repeated on every part in general, but in a greater degree on those places where the varnish appears to lie thicker than on the rest : and in doing this, both hands are, for dispatch, employed at the same time. When this operation is finished, the skins are still to be left on the boards where they were stretched and nailed ; and those boards are, therefore, either continued till that time on the treffels where the varnish was put on the skin ; or, if they be wanted for fresh skins, taken off, and fixed up against the wall of the place, or any other proper support. The time of drying depends of course on the heat of the sun and weather ; but at a seasonable time does not exceed a few hours. It is to be known, as to each particular parcel of skins, by examining them with the finger. If on touching them, they be found free from any stickiness, or, in the style of workmen, tackiness, or that the finger makes no impression on the varnish, they may be concluded sufficiently dry ; and the contrary, when they are found to be otherwise. This coat of varnish being dry, the skins are to be again put on the treffels as before, and another coat laid on exactly in the same manner as the first. In doing this, examination must be made, whether any of the skins appear stronger or weaker coloured than the others ; in order that the defect may be now remedied, by making this coat thicker or thinner, as may appear necessary. When this coat is dry, the varnishing for producing the appearance of gilding is completed : and if it has been well performed,

the leather will have a very fine gold colour, with a considerable degree of polish or brightness. When there is an intention to have one part of the leather silver, and the other gold, a pattern is formed on the surface, by printing, calking, or stamping a design on the surface after the silvering. The skin is then to be varnished, as if the whole were intended to be gold; but after the last coat, instead of drying the varnish, it is to be immediately taken off that part which is intended to be silver, according to the design printed or calked upon it, by a knife; with which the workman scrapes off all that he can without injuring the silver, and afterwards by a linen cloth, with which all that remains is endeavoured to be wiped or rubbed off. The skins, being thus silvered and varnished, are made the ground of various designs for embossed work and painting. The embossed work or relief is raised by means of printing with a rolling press, such as is used for copper plates; but the design is here to be engraved on wood. The painting may be of any kind: but oil is principally used, as being durable and most easily performed. There is nothing more necessary in this case, than in painting on other grounds, except that, where varnish or water is used, the surface be clean from any oily or greasy matter.

*Of gilding of glass without annealing or burning.]*  
 Glass may be gilt, by applying as a cement, any gold size, or other size, gum water or varnish; and, when it is of a proper degree of dryness, laying on the gold, as in the other methods of gilding. The work may also be polished afterwards in the same manner, if the burnished appearance be desired: but where that is intended, it is proper to add bole ammoniac, chalk, or other such substance, to the cement. When drinking-glasses are to be gilt, without burning, the cement should be either some gold size formed of oil, or some kind of varnish compounded of the gum resins, that will not dissolve in water; but require either spirit of wine or oil of turpentine for their solution. At present, nevertheless, this is not only neglected by those who gild

drinking-glasses for sale ; but glasses gilded with gum arabic, or the sizes which will dissolve in water, are imposed upon the public for the German glasses gilt with the annealed gold ; and sold at the dear rate under that pretence ; though after they have been used for a very short time, the gold peels and rubs off in spots when the glasses are cleaned ; and renders them very unsightly. As the glasses with gilt edges are at present much in fashion, and the true kind are brought from Germany, or elsewhere, the incitement of the cultivating this branch of gilding here, would not be an unfit object of the premiums of the worthy society for the encouragement of arts. Since for the doing this work in perfection, there is nothing more wanting, than that dexterity of the manoeuvre, which arises from a little practice in matters of this kind.

*Of silvering.*] Silvering may be practised on the same substances ; and all by the same methods, either with leaf or powder, as we have before pointed out with regard to gilding ; variation being made in a few circumstances below mentioned. It is, nevertheless, but seldom used, notwithstanding the effect would be very beautiful and proper in many cases ; and there is an extreme good reason for such a neglect of it. This reason is, its tarnishing in a very short time ; and acquiring frequently, besides the general depravity of the whiteness, such spots of various colours, as render it very unsightly : and this tarnish and specking is not only the constant result of time, but will be often produced instantly by any extraordinary moisture in the air, or dampness, as well as by the fumes and effluvia of many bodies which may happen to approach it. Wherever, therefore, silvering is admitted, a strong varnish ought to be put over it : and this even is not sufficient wholly to secure it from this destructive consequence. The varnish must be some of the compositions of mastic, sandrac, the gums animi or copal, and white resin ; (the particular treatment of which in the forming varnishes will be found in other parts of this work) for the other substances used for compounding varnishes are too yellow. Some put a

coat of isinglass size over the silver ; but, besides that the size itself injures the whiteness in time, by turning yellow, it preserves the silver but in a small degree. Experience has shown, in the case of the silvered leather, what the varnish may be composed of, that answers best for this purpose, and the kind before given, p. 28, under that head, may be applied to other purposes. The methods of making the silver powders, is also the same as those of gold, except with regard to one of the German powders, which is correspondent both in its appearance and use, abating the difference of colour, to *aurum Mosaicum* or *musivum* : whence it has been indeed, though improperly, called the *argentum musivum*. The process for this being, therefore, different from any before given, it is proper to insert it fully, as follows : —“ Take of very pure tin one pound : put it into a crucible, and set it on a fire to melt : when it begins to run into fusion, add to it an equal proportion of bismuth or tin glass : and stir the mixture with an iron rod, or the small end of a tobacco-pipe, till the whole be intirely melted, and incorporated. Take the crucible then from the fire ; and, after the melted composition is become a little cooler, but while it is yet in a fluid state, pour into it a pound of quicksilver gradually ; stirring it in the mean time, that the mercury may be thoroughly conjoined with the other ingredients. When the whole is thus commixt, pour the mass out of the crucible on the stone ; where, as it cools, it will take the form of an amalgama or metalline paste ; which will be easily bruised into a flasky powder ; and is then fit for use.” — This powder may be either tempered, in the manner of the shell gold, with gum water ; or rubbed over a ground properly sized, according to any of the methods above directed for gold powder ; and it will take a very good polish from the dog’s tooth or burnishers, and hold its colour much better with a slight coat of varnish over it, than any true silver powder or leaf. The sizes for silvering ought not to be mixed, as in the case of gold, with yellow, or bole ammoniac : but with some white substance, whose effect may prevent

any small failures in the covering the ground with the silver from being seen, in the same manner as the yellow substances do the gold. This may be done with flake white, or white lead, when the sizes formed of oil are used : but whiting is the proper matter in the burnish size for silvering ; or wherever the glover's or parchment size is used. Some recommend tobacco pipe clay in the place of whiting ; and add a little lamp-black to give a silver-like greyishness to the composition. Leather is silvered by those who have the manufactures of hangings, skreens, &c. though not so frequently with a view to the retaining its own colour, as to produce the imitation of gilding, of which the whole process is before given, p. 22. In some cases, nevertheless, the appearance of silver is retained ; and it is therefore proper to take some notice of the manner of performing this work. The proceeding in silvering the leather, is to be in all respects the same, as when it is to have the appearance of gilding (of which the particular manner has been before shown under the article of gilding leather) till that part of the process where the varnish or laquer, which is to give the yellow colour, is to be laid on. Instead of this yellow varnish, a clear colourless one is to be substituted, where the appearance of silver is to be preserved : but this is necessary only, in order to prevent the tarnish and discolouring, which of course happens in a short time to silver exposed in a naked and undefended state to the air. The most common varnish used for this purpose, is only parchment size, prepared as above directed, p. 7, which is preferred to others, on account of its cheapness. This is made warm, in order to render it fluid, and then laid on with a sponge instead of a pencil or brush. There is no reason, however, as this kind of varnish is liable to suffer by moisture, and grow foul and discoloured, that better kinds, such as those of Martin, or others, which are used for *papier mache*, wood, &c. should not be employed here, provided they be colourless. The more hard and transparent, and the more they are of a resinous nature, the more brilliant and white, and the more durable will be



the silvery, and polished appearance of the silver leather. Some, instead of parchment size, use that made of isinglass, which may be prepared according to the method laid down, p. 7. This resists moisture, and will keep its colour and transparency, better than the other kinds of size : but all of them grow yellow and cloudy with time ; especially if any damper moisture have access to them. Indeed silver secured even by the best varnish, will still in time take a tarnish, and lose its beauty : and therefore the giving the leaf silver on leather the appearance of gold, even tho' attended with some additional expence, is preferable in most cases. Leather silvered in this manner may be ornamented by printing in relief, and by painting, in the same manner as that representing gilding : though, on account of the want of durability, this is much seldomer practised. It is possible that some amalgama of quicksilver, or other composition, might be found that would have the resemblance of silver, and yet resist tarnishing : which would not only be a great improvement, by the furnishing a durable kind of silvering for leather, paper, &c. but also save part of the expence of leaf silver for a ground for gilded leather. This has been attempted in France with some success ; but not to the degree of perfection wished for.

*Of bronzing.*] Bronzing is colouring, by metalline powders, plaster, or other busts and figures, in order to make them appear as if cast of copper or other metals. This is sometimes done by means of cement, and sometimes without, in the instance of plaster figures : but the bronzing is more durable and secure when a cement is used. The gold powders, and the *aurum Mosaicum*, we have before given the preparation of, are frequently employed for this purpose ; but the proper bronzing ought to be of a deeper and redder colour, more resembling copper ; which effect may be produced by grinding a very small quantity of red lead with these powders ; or the proper powder of copper may be used : and may be prepared as follows——“ Take filings of copper, or slips of copper-plates, and dissolve

them in any kind of *aqua fortis* put into a glass receiver, or other proper formed vessel. When the *aqua fortis* is saturated with the copper, take out the slips of the plates ; or, if filings were used, pour off the solution from what remains undissolved, and put into it small bars of iron : which will precipitate the copper from the *aqua fortis* in a powder of the proper appearance and colour of copper. Pour off the water then from the powder ; and wash it clean from the salts, by several successive quantities of fresh water.”——Where the appearance of brass is designed, the gold powders, or the *aurum Mosaicum*, may be mixed with a little of the powder called *argentum musivum* ; of which the preparation is above given. Where the appearance of silver is wanted, the *argentum musivum* is the best and cheapest method ; particularly as it will hold its colour much longer than the true silver used either in leaf or powder. Where no cement is used in bronzing, the powder must be rubbed on the subject intended to be bronzed, by means of a piece of soft leather, or fine linen rag, till the whole surface be coloured. The former method of using a cement in bronzing was, to mix the powders with strong gum water, or isinglass size ; and then with a brush, or pencil, to lay them on the subject. But at present some use the japanners gold size : and proceed in all respects in the same manner as in gilding with the powders in other cases : for which ample directions have been before given. This is the best method hitherto practised. For the japanners gold size binds the powders to the ground, without the least hazard of peeling or falling off ; which is liable to happen when the gum water or glover’s or isinglass sizes are used. Though, notwithstanding the authority of the old practice for the contrary, even these cements will much better secure them when they are laid on the ground, and the powders rubbed over them, than when both are mixed together, and the effect, particularly of the *aurum Mosaicum*, will be much better in this way than the other. The gold size should be suffered, in this case, to approach much nearer to dryness, than is proper in

the case of gilding with leaf gold, as the powders would otherwise be rubbed amongst it in the laying them on. The fictitious silver powder, called the *argentum musivum*, may, as above-mentioned, be applied in the manner of bronze, by those whose caprice disposes them to silver figures or busts. But it is the only sort of silver powder that should be used in this way, for the reason above given: and all such kind of silvering is much better omitted. For the whiteness itself of plaister in figures or busts, and much more a glossy or shining whiteness, is injurious to their right effect; by its eluding the judgment of the eye, with respect to the proper form and proportion of the parts from the false and pointed reflections of the lights, and the too faint force of the shades. To remove which inconvenience it is probable was the first inducement to bronzing.

*Of japanning.*] By japanning is to be here understood the art of covering bodies by grounds of opaque colours in varnish; which may be either afterwards decorated by paintings or gilding, or left in a plain state. This is not at present practised so frequently on chairs, tables, and other furniture of houses, except tea-waiters, as formerly. But the introduction of it for ornamenting coaches, snuff-boxes, and skreens, in which there is a rivalry betwixt ourselves and the French, renders the cultivation and propagation of this art of great importance to commerce. I shall therefore be more explicit in showing the methods both now and formerly in use; with the application of each to the several purposes to which they are best adapted; and point out at the same time several very material improvements, that are at present only enjoyed by particular persons; or not at all hitherto brought into practice. The substances which admit of being japanned are almost every kind that are dry and rigid, or not too flexible; as wood, metals, leather, and paper prepared. Wood and metals do not require any other preparation, but to have their surfaces perfectly even and clean. But leather should be securely strained

either on frames or on boards ; as its bending or forming folds would otherwise crack and force off the coats of varnish. Paper also should be treated in the same manner ; and have a previous strong coat of some kind of size ; but it is rarely made the subject of japanning till it is converted into *papier mache*, or wrought, by other means, into such form, that its original state, particularly with respect to flexibility, is lost. One principal variation in the manner of japanning is, the using or omitting any priming or undercoat on the work to be japanned. In the older practice, such priming was always used ; and is at present retained in the French manner of japanning coaches and snuff boxes of the *papier mache*. But in the Birmingham manufacture here, it has been always rejected. The advantage of using such priming or undercoat is, that it makes a saving in the quantity of varnish used ; because the matter of which the priming is composed, fills up the inequalities of the body to be varnished ; and makes it easy, by means of rubbing and water-polishing, to gain an even surface for the varnish. This was therefore such a convenience in the case of wood, as the giving a hardness and firmness to the ground, was also in the case of leather, that it became an established method : and is therefore retained, even in the instance of the *papier mache*, by the French, who applied the received method of japanning to that kind of work on its introduction. There is nevertheless this inconvenience always attending the use of an undercoat of size, that the japan coats of varnish and colour will be constantly liable to be cracked and peeled off, by any violence, and will not endure near so long as the bodies japanned in the same manner, but without any such priming. This may be easily observed in comparing the wear of the Paris and Birmingham snuff boxes ; which latter, when good of their kind, never peel or crack, or suffer any damage, unless by great violence, and such a continued rubbing, as wastes away the substance of the varnish : while the japan coats of the Parisian boxes crack and fly off in

flakes, whenever any knock or fall, particularly near the edges, exposes them to be injured. But the Birmingham manufacturers, who originally practised the japanning only on metals, to which the reason above given for the use of priming did not extend, and who took up this art of themselves as an invention, of course omitted at first the use of any such undercoat; and not finding it more necessary in the instance of *papier mache*, than on metals, continue still to reject it. On which account the boxes of their manufacture are, with regard to the wear, greatly better than the French. The laying on the colours, in varnish instead of gum water, is also another variation from the method of japanning formerly practised. But the much greater strength of the work, where they are laid on in varnish or oil, has occasioned this way to be exploded, with the greatest reason, in all regular manufactures. However, they who may practise japanning on cabinets, or other such pieces, as are not exposed to much wear and violence, for their amusement only, and consequently may not find it worth their while to encumber themselves with the preparations necessary for the other methods, may paint with water colours on an undercoat laid on the wood, or other substance, of which the piece to be japanned is formed; and then finish with the proper coats of varnish, according to the methods below taught. If the colours are tempered with the strongest isinglass size and honey, instead of gum water, and laid on very flat and even, the work will not be much inferior in appearance to that done by the other method; and will last as long as the common old japan work, except the best kinds of the true japan. It is practised likewise, in imitation of what is sometimes done in the Indian work, to paint with water colours on grounds of gold; in which case the isinglass size, with sugar-candy or honey, as above directed, is the best vehicle. Imitations are also made of japan work, by colouring prints, gluing them to wood-work, and giving them a shining appearance, by the use of some white varnish.



*Of japan grounds.*] The proper japan grounds are either such as are formed by the varnish and colour, where the whole is to remain of one simple colour; or by the varnish either coloured or without colour, on which some painting or other decoration, is afterwards to be laid on. It is necessary, however, before I proceed to speak of the particular grounds, to shew the manner of laying on the priming or undercoat, where any such is used. This priming is of the same nature with that called clear coating (or vulgarly clear coaling) practised erroneously by house-painters; and consists only in laying on, and drying in the most even manner, a composition of size and whiting. The common size has been generally used for this purpose: but where the work is of a nicer kind, it is better to employ the glover's or the parchment size; and if a third of isinglass be added, it will be still better; and if not laid on too thick, much less liable to peel and crack. The work should be prepared for this priming, by being well smoothed with the fish skin, or glass shaver; and, being made thoroughly clean, should be brushed over once or twice with hot size, diluted with two thirds of water, if it be of the common strength. The priming should then be laid on with a brush as even as possible; and should be formed of a size, whose consistence is betwixt the common kind and glue, mixed with as much whiting as will give it a sufficient body of colour to hide the surface of whatever it is laid upon, but not more. If the surface be very even, on which the priming is used, two coats of it, laid on in this manner, will be sufficient: but if, on trial with a fine rag wet, it will not receive a proper water polish, on account of any inequalities not sufficiently filled up and covered, two or more coats must be given it: and whether a greater or less number be used, the work should be smoothed, after the last coat but one is dry, by rubbing it with the Dutch rushes. When the last coat is dry, the water polish should be given, by passing over every part of it with a fine rag gently moistened, till the whole appear perfectly clean and even. The prim-

ing will then be completed, and the work ready to receive the painting, or coloured varnish : the rest of the proceedings being the same in this case, as where no priming is used.

*Of common grounds of varnish which are to be painted upon.*] Where wood or leather is to be japanned, and no priming is used, the best preparation is to lay two or three coats of coarse varnish composed in the following manner.—“ Take of rectified spirit of wine one pint, and of coarse seed-lac and resin, each two ounces. Dissolve the seed-lac and resin in the spirit : and then strain off the varnish.”— This varnish, as well as all others formed of spirit of wine, must be laid on in a warm place ; and, if it can be conveniently managed, the piece of work to be varnished should be made warm likewise : and for the same reason, all dampness should be avoided ; for either cold or moisture chill this kind of varnish ; and prevent its taking proper hold of the substance on which it is laid. When the work is so prepared, or by the priming of the composition of size and whiting above described, the proper japan ground must be laid on, which is much the best formed of shell-lac varnish, and the colour desired ; if white be not in question, which demands a peculiar treatment, as I shall below explain ; or great brightness be not required, when also other means must be pursued. The colours used with the shell-lac varnish, may be any pigments whatever which give the tint of the ground desired ; and they may be mixed together to form browns or any compound colours : but with respect to such as require peculiar methods for the producing them of the first degree of brightness, I shall particularize them below. The colours for grounds may otherwise be mixed with the white varnishes formed in oil of turpentine ; but these varnishes have no advantages over the shell-lac but in their whiteness, that preserves the brightness of the colours ; and they are at the same time greatly inferior in hardness to it. As metals never require to be under coated with whiting,

they may be treated in the same manner as wood or leather when the under-coat is omitted, except in the instances particularly spoken of below.

*Of white japan grounds.*] The forming a ground perfectly white, and of the first degree of hardness, remains hitherto a desideratum, or matter sought for in the art of japanning. As there are no substances which can be dissolved, so as to form a very hard varnish, but what have too much colour not to deprave the whiteness, when laid on of a due thickness over the work, except some very late discoveries not hitherto brought into practice. The nearest approach, however, to a perfect white varnish, by means already known to the public, is made by the following composition.—“Take flake white, or white lead, washed over and ground with a sixth of its weight of starch, and then dried; and temper it properly for spreading, with the mastic varnish, or compound them with the gum animi.”—Lay these on the body to be japanned, prepared either with or without the under-coat of whiting, in the manner as above ordered; and then varnish over it with five or six coats of the following varnish.—“Provide any quantity of the best seed lac; and pick out of it all the clearest and whitest grains; reserving the more coloured and fouler parts for the coarser varnishes, such as that above mentioned for priming or preparing wood or leather. Take of this picked seed lac two ounces; and of gum animi three ounces; and dissolve them, being previously reduced to a gross powder, in about a quart of spirit of wine; and strain off the clear varnish.”—The seed lac will yet give a slight tinge to this composition; but cannot be omitted, where the varnish is wanted to be hard: though, where a softer will answer the end, the proportion may be diminished; and a little crude turpentine added to the gum animi, to take off the brittleness. A very good varnish, free entirely from all brittleness, may be formed, by dissolving as much gum animi, as the oil will take, in old nut or poppy oil; which must be made to boil

gently, when the gum is put into it. The ground of white colour itself may be laid on in this varnish; and then a coat or two of it may be put over the ground: but it must be well diluted with oil of turpentine when it is used. This, though free from brittleness, is, nevertheless, liable to suffer; by being indented or bruised by any slight strokes; and it will not well bear any polish, but may be brought to a very smooth surface without, if it be judiciously managed in the laying it on. It is likewise somewhat tedious in drying, and will require some time where several coats are laid on, as the last ought not to contain much oil of turpentine. It must be observed, likewise, that the gum resin, such as the animi, copal, &c. can never be dissolved in substantial oils, by the medium of heat, without a considerable change in the colour of the oils, by the degree of heat necessary to produce the solution. A method of dissolving gum copal in oil of turpentine is, however, now discovered by a gentleman of great abilities in chemistry; and he has also obtained a method of dissolving amber in the same menstruum, so that we may hope soon to see the art of japanning carried to a consummate degree of perfection; when the public are put in possession of these most important inventions, or the fruits of them.

*Of blue japan grounds.]* Blue japan grounds may be formed of bright Prussian blue; or of verditer glazed over by Prussian blue; or of smalt. The colour may be best mixed with shell-lac varnish; and brought to a polishing state by five or six coats of varnish of seed-lac. But the varnish, nevertheless, will somewhat injure the colour, by giving to a true blue a cast of green; and fouling in some degree a warm blue, by the yellow it contains. Where, therefore, a bright blue is required, and a less degree of hardness can be dispensed with, the method before directed, in the case of white grounds, must be pursued.

*Of red japan grounds.]* For a scarlet japan ground, vermillion may be used. But the vermillion alone has

a glaring effect, that renders it much less beautiful than the crimson produced by glazing it over with carmine or fine lake ; or even with rose pink, which has a very good effect used for this purpose. For a very bright crimson, nevertheless, instead of glazing with carmine, the Indian lake, known in the shops by the name of *safflower*, should be used, dissolved in the spirit of which the varnish is compounded (which it readily admits of when good). But in this case, instead of glazing with the shell-lac varnish, the upper or polishing coats need only be used ; as they will equally receive and convey the tinge of the Indian lake, which may be actually dissolved by spirit of wine : and this will be found a much cheaper method than the using carmine. If, nevertheless, the highest degree of brightness be required, the white varnishes must be used. It is at present, however, very difficult to obtain this kind of lake. For it does not appear that more than one considerable quantity was ever brought over, and put into the hands of colourmen : and this being now expended, they have not the means of a fresh supply : it, however, may be easily had from the same place whence the former quantity was procured, by any persons who go thither in the East-India ships.

*Of yellow japan grounds.*] For bright yellow grounds, King's yellow, or turpeth mineral, should be employed, either alone or mixed with fine Dutch pink. The effect may be still more heightened, by dissolving powdered turmeric root in the spirit of wine, of which the upper or polishing coat is made ; which spirit of wine must be strained from off the dregs, before the seed-lac be added to it to form the varnish. The seed-lac varnish is not equally injurious here, and with greens, as in the case of other colours ; because, being only tinged with a reddish yellow, it is little more than an addition to the force of the colours. Yellow grounds may be likewise formed of the Dutch pink only, which, when good, will not be wanting in brightness, though extremely cheap.



*Of green japan grounds.]* Green grounds may be produced by mixing King's yellow and bright Prussian blue; or rather, turpeth mineral and Prussian blue. A cheap, but fouler kind, may be had from verdigrise, with a little of the above mentioned yellows, or Dutch pink. But where a very bright green is wanted, the crystals of verdigrise, (called *distilled verdigrise*) should be employed; and to heighten the effect, they should be laid on a ground of leaf gold, which renders the colour extremely brilliant and pleasing. They may any of them be used successfully with good seed-lac varnish, for the reason before given: but will be still brighter with the white varnish.

*Of orange-coloured japan grounds.]* Orange-coloured japan grounds may be formed, by mixing vermillion, or red lead, with King's yellow, or Dutch pink; or the orange lake; or red orpiment, will make a brighter orange ground than can be produced by any mixture.

*Of purple japan grounds.]* Purple japan grounds may be produced by the mixture of lake, and Prussian blue; or a fouler kind, by vermillion and Prussian blue. They may be treated as the rest, with respect to the varnish.

*Of black japan grounds, to be produced without heat.]* Black grounds may be formed by either ivory-black, or lamp-black: but the former is preferable, where it is perfectly good. These may be always laid on with the shell-lac varnish: and have their upper or polishing coats of common seed-lac varnish; as the tinge or foulness of the varnish can be here no injury.

*Of common black japan grounds on iron or copper, produced by means of heat.]* For forming the common black japan grounds by means of heat, the piece of work to be japanned must be painted over with drying oil: and when it is of a moderate dryness, must be put into a stove of such degree of heat, as will change the oil black, without burning it, so as to destroy or weaken its tenacity. The stove should not be too hot when the work is put into it, nor the heat increased too

fast ; either of which errors would make it blister : but the slower the heat is augmented, and the longer it is continued, provided it be restrained within the due degree, the harder will be the coat of japan. This kind of varnish requires no polishing, having received, when properly managed, a sufficient one from the heat.

*Of the fine tortoise-shell japan ground, produced by means of heat.*] The best kind of tortoise-shell ground produced by heat is not less valuable for its great hardness, and endured to be made hotter than boiling water without damage, than for its beautiful appearance. It is to be made by means of a varnish prepared in the following manner.—“Take of good linseed oil one gallon, and of umbre half a pound. Boil them together till the oil become very brown and thick : strain it then through a coarse cloth ; and set it again to boil ; in which state it must be continued till it acquire a pitchy consistence, when it will be fit for use.”—Having prepared thus the varnish, clean well the iron or copper plate, or other piece which is to be japaned ; and then lay vermilion tempered with shell-lac varnish, or with drying oil diluted with oil of turpentine very thinly, on the places intended to imitate the more transparent parts of the tortoise-shell. When the vermilion is dry, brush over the whole with the black varnish, tempered to a due consistence with oil of turpentine ; and when it is set and firm, put the work into a stove, where it may undergo a very strong heat ; and must be continued a considerable time, if even three weeks or a month, it will be the better. This was given amongst other recipes by Kunckel ; but appears to have been neglected till it was revived with great success in the Birmingham manufactures, where it was not only the ground of snuff-boxes, dressing-boxes, and other such lesser pieces, but of those beautiful tea waiters, which have been so justly esteemed and admired in several parts of Europe where they have been sent. This ground may be decorated with painting and gilding, in the same manner as any other var-

nished surface, which had best be done after the ground has been duly hardened by the hot stove : but it is well to give a second annealing with a more gentle heat after it is finished.

*Of painting japan work.*] Japan work ought properly to be painted with colours in varnish. But in order for the greater dispatch, and, in some very nice works in small, for the freer use of the pencil, the colours are now most frequently tempered in oil: which should previously have a fourth part of its weight of gum animi dissolved in it; or, in default of that, of the gums sandrac or mastic, as I have likewise before intimated. When the oil is thus used, it should be well diluted with spirit of turpentine, that the colours may be laid more evenly and thin: by which means, fewer of the polishing or upper coats of varnish become necessary. In some instances, water colours, as I before mentioned, are laid on grounds of gold, in the other paintings; and are best, when so used, in their proper appearance, without any varnish over them; and they are also sometimes so managed, as to have the effect of embossed work. The colours employed in this way for painting, are (as I before intimated) best prepared by means of isinglass size corrected with honey, or sugar-candy. The body of which the embossed work is raised, need not, however, be tinged with the exterior colour; but may be best formed of very strong gum water, thickened to a proper consistence by bole ammoniac and whiting in equal parts: which being laid on in the proper figure, and repaired when dry, may be then painted with the proper colours tempered in the isinglass size, or in the general manner with shell-lac varnish.

*Of varnishing japan work.*] The last, and finishing part of jappanning, lies in the laying on and polishing the outer coats of varnish; which are necessary, as well in the pieces that have only one simple ground of colour; as with those that are painted. This in general is best done with common seed-lac varnish; except in

the instances, and on those occasions, where I have already shown other methods to be more expedient: and the same reasons, which decide as to the fitness or impropriety of the varnishes, with respect to the colours of the ground, hold equally well with regard to those of the painting. For where brightness is the most material point, and a tinge of yellow will injure it, seed-lac must give way to the whiter gums. But where hardness, and a greater tenacity, are most essential, it must be adhered to: and where both are so necessary, that it is proper one should give way to the other, in a certain degree reciprocally, a mixed varnish must be adopted. This mixed varnish, as I before observed, should be made of the pick'd seed-lac, as directed in p. 43. The common seed-lac varnish, which is the most useful preparation of the kind hitherto invented, may be thus made. "Take of seed-lac three ounces, and put into water to free it from the sticks and filth that frequently are intermixed with it; and which must be done by stirring it about, and then pouring off the water and adding fresh quantities, in order to repeat the operations till it be free from all impurities; as it very effectually may be by this means. Dry it then, and powder it grossly; and put it, with a pint of rectified spirit of wine, into a bottle, of which it will not fill above two-thirds. Shake the mixture well together, and place the bottle in a gentle heat, till the seed appear to be dissolved; the shaking being in the mean time repeated as often as may be convenient; and then pour off all which can be obtained clear by that method: and strain the remainder through a coarse cloth. The varnish thus prepared must be kept for use in a bottle well stop'd."—When the spirit of wine is very strong, it will dissolve a greater proportion of the seed-lac: but this will saturate the common, which is seldom of a strength sufficient for making varnishes in perfection. As the chilling, which is the most inconvenient accident attending those of this kind, is prevented, or produced more frequently, according to the strength of the

spirit, I will take this opportunity of showing a method by which weaker rectified spirits may with great ease, at any time, be freed from the phlegm, and rendered of the first degree of strength.—“Take a pint of the common rectified spirit of wine, and put it into a bottle, of which it will not fill above three parts. Add to it half an ounce of pearl-ashes, salt of tartar, or any other alkaline salt, heated red-hot, and powdered, as well as it can be without much loss of its heat. Shake the mixture frequently for the space of half an hour; before which time, a great part of the phlegm will be separated from the spirit; and will appear, together with the undissolved part of the salts in the bottom of the bottle. Let the spirit then be poured off, or freed from the phlegm and salts by means of a *tritorium*, or separating funnel; and let half an ounce of the pearl-ashes, heated and powdered as before, be added to it, and the same treatment repeated. This may be done a third time, if the quantity of phlegm separated by the addition of the pearl-ashes appear considerable. An ounce of alum reduced to powder and made hot, but not burned, must then be put into the spirit; and suffered to remain some hours; the bottle being frequently shaken. After which, the spirit, being poured off from it, will be fit for use.”—The addition of the alum is necessary, to neutralize the remains of the alkaline salt or pearl-ashes; which would otherwise greatly deprave the spirit with respect to varnishes and laques, where vegetable colours are concerned; and must consequently render another distillation necessary. The manner of using the seed-lac, or white varnishes, is the same; except with regard to the substance used in polishing; which where a pure white, or great clearness of other colours, is in question, should be itself white: whereas the browner sorts of polishing dust, as being cheaper, and doing their business with greater dispatch, may be used in other cases. The pieces of work to be varnished should be placed near a fire, or in a room where there is a stove; and made perfectly dry: and then the varnish may be rubbed over them by the



proper brushes made for that purpose, beginning in the middle, and passing the brush to one end; and then, with another stroke from the middle, passing it to the other. But no part should be crossed or twice passed over, in forming one coat, where it can possibly be avoided. When one coat is dry, another must be laid over it; and this must be continued at least five or six times, or more; if, on trial, there be not a sufficient thickness of varnish to bear the polish, without laying bare the painting, or the ground colour underneath. When a sufficient number of coats is thus laid on, the work is fit to be polished: which must be done, in common cases, by rubbing it with a rag dipped in tripoli (commonly called *rotten stone*), finely powdered. But towards the end of the rubbing, a little oil of any kind should be used along with the powder; and when the work appears sufficiently bright and glossy, it should be well rubbed with the oil alone, to clean it from the powder; and give it a still brighter lustre. In the case of white grounds, instead of the tripoli, fine putty or whiting must be used; both which should be washed over, to prevent the danger of damaging the work from any sand or other gritty matter, that may happen to become mixed with them. It is a great improvement of all kinds of japan work, to harden the varnish by means of heat; which, in every degree that it can be applied short of what would burn or calcine the matter, tends to give it a more firm and strong texture. Where metals form the body, therefore, a very hot stove may be used, and the pieces of work may be continued in it a considerable time; especially if the heat be gradually increased. But where wood is in question, heat must be sparingly used; as it would otherwise warp or shrink the body, so as to injure the general figure.

[ *Of gilding japan work.* ] All the methods of gilding, which are applicable to the ornamenting japan work, having been before taught under the article of gilding, it is needless to repeat them here. I shall therefore only again observe, that in gilding with gold size (which is

almost the only method now practised in japan work) where it is desired to have the gold not to shine, or approach in the least towards the burnishing state, the size should be used either with oil of turpentine only, or with a very little fat oil. But where a greater lustre, and appearance of polish, are wanting, without the trouble of burnishing, and the preparation necessary for it, fat oil alone, or mixed with a little gold size, should be used; and the same proportionable effect will be produced from a mean proportion of them.

*Of laquering.*] Laquering is the laying either coloured or transparent varnishes on metals, in order to produce the appearance of a different colour in the metal; or to preserve it from rust and the injuries of the weather. Laquering is therefore much of the same nature with japanning, both with regard to the principles and practice; except that no opaque colours, but transparent tinges alone, are to be employed. The occasions on which laquering is now in general used, are three: where brass is to be made to have the appearance of being gilt: where tin is wanted to have the resemblance of yellow metals: and where brass or copper locks, nails, or other such matters, are to be defended from the corrosion of the air or moisture. There was indeed formerly another very frequent application of laquering; which was colouring frames of pictures, &c. previously silvered, in order to give them the effect of gilding; but this is now greatly disused. These various intentions of laquering require different compositions for the effectuating each kind; and as there is a multiplicity of ingredients which may be conducive to each purpose, a proportionable number of recipes have been devised, and introduced into practice; especially for the laquering brass work to imitate gilding; which is a considerable object in this kind of art; and has been improved to the greatest degree of perfection. I shall, however, only give one or two recipes for each; as they are all which are necessary; the others being either made too complex by ingredients not essential to the intention, or too costly by the use of such as are expensive; or inferior in goodness, from the im-

proper choice or proportion of the component substances. The principal body or matter of all good laquers used at present is seed-lac ; but, for coarser uses, resin or turpentine is added ; in order to make the laquer cheaper, than if the seed lac, which is a much dearer article, be used alone. Spirit of wine is also consequently the fluid or menstruum of which laquers is formed ; as the ethereal oils will not dissolve the seed-lac : and it is proper that the spirit should be highly rectified for this purpose. As it is seldom practicable, nevertheless, to procure such spirits from the shops, it will be found very advantageous to use the method above given for dephlegmating it by alkaline salts ; but the use of the alum, directed in that process, must not be forgotten on this occasion ; as the effect of the alkaline salt would otherwise be the turning the metal of a purplish, instead of a golden colour, by laying on the laquer. The following are excellent compositions for brass work which is to resemble gilding.—“ Take of turmeric ground, as it may be had at the dry salters, one ounce, and of saffron and Spanish annatto each two drachms. Put them into a proper bottle, with a pint of highly-rectified spirit of wine ; and place them in a moderate heat, if convenient, often shaking them, for several days. A very strong yellow tincture will then be obtained ; which must be strained off from the dregs through a coarse linen cloth : and then, being put back into the bottle, three ounces of good seed-lac powdered grossly must be added, and the mixture placed again in a moderate heat, and shaken, till the seed-lac be dissolved ; or at least such part of it as may. The laquer must then be strained as before ; and will be fit for use ; but must be kept in a bottle carefully stoppt.”——Where it is desired to have the laquer warmer or redder than this composition may prove, the proportion of the annatto must be increased ; and where it is wanted cooler, or nearer a true yellow, it must be diminished. The above, properly managed, is an extreme good laquer ; and of moderate price ; but the following, which is cheaper, and may be made where the Spanish annatto cannot be procured good is not greatly inferior to it.—“ Take a turmeric roo

ground one ounce, of the best dragon's blood half a drachm. Put them to a pint of spirit of wine, and proceed as with the above."—By diminishing the proportion of the dragon's blood, the varnish may be rendered of a redder, or truer yellow cast. Saffron is sometimes used to form the body of colour in this kind of laquer, instead of the turmeric; but though it makes a warmer yellow, yet the dearth of it, and the advantage which turmeric has in forming a much stronger tinge in spirit of wine, not only than the saffron, but than any other vegetable matter hitherto known, gives it the preference. Tho' being a true yellow, and consequently not sufficiently warm to overcome the greenish cast of brass, it requires the addition of some orange coloured tinge to make a perfect laquer for this purpose. Aloes and gamboge are also sometimes used in laquers for brass: but the aloes is not necessary where turmeric or saffron are used; and the gamboge, though a very strong milky yellow in water, affords only a very weak tinge in spirit of wine. The varnish for tin may be made as follows:—"Take of turmeric root one ounce, of dragon's blood two drachms, and of spirit of wine one pint. Proceed as in the former."—This may, like the former, have the red or yellow rendered more prevalent, by the increasing or diminishing the proportion of the dragon's blood. Where a coarser or cheaper kind is wanted, the quantity of seed-lac may be abated; and the deficiency thence arising supplied by the same proportion of resin. The laquer for locks, nails, &c. where little or no colour is desired, may either be seed-lac varnish alone, as prepared above, or with a little dragon's blood: or a compound varnish of equal parts of seed-lac and resin, with or without the dragon's blood. The laquer for picture frames, &c. where the ground is silver, and the appearance of gilding is to be produced, may be the composition before given, p. 28, for gilding leather: the principle being exactly the same in this case and that. The manner of laying on the laquer is as follows: First let the pieces of work to be laquered, be made thoroughly clean; which, if they be new founded, must be done by means of aqua-



*fortis*. Being ready, they must be heated by a small charcoal fire in a proper vessel, or any way that may be most convenient: the degree must not be greater than will admit of their being taken hold of without burning the hand. The laquer must then be laid on by a proper brush in the manner of other varnishes; and the pieces immediately set again in the same warm situation. After the laquer is thoroughly dry and firm, the same operation must be renewed again for four or five times, or till the work appear of the colour and brightness intended. For very fine work, some use a less proportion of seed-lac; which occasions the laquer to lie even on the metal: but, in this case, a greater number of coats are required; which multiplies the proportion of labour; though, where the price of the work will allow for such additional trouble, it will be the more perfect for it. The laquering tin may be performed in the same manner, as is here directed for brass: but being for coarser purposes, less nicety is observed; and fewer coats (or perhaps one only) are made to suffice; as the laquer is compounded very red, that the tinge may have the stronger effect. Locks, nails, &c. where laquer is only used in a defensive view, to keep them from corroding, and not for the improvement of the colour, may be treated in the same manner: but one or two coats are generally thought sufficient. Though where any regard is had to the wear, the coats of laquer or varnish should always be of a due thickness, when they are to be exposed to the air; otherwise, the first moist weather makes them chill, and look grey and milky, in such manner, that they are rather injurious than beneficial to the work they are laid upon. The laquering picture frames, &c. where the ground is leaf silver, may be performed in the same manner as was before directed in the case of gilding leather; the circumstances being nearly the same, except with relation to the texture of the subject; to suit which, the different manner of treatment may be easily adapted. But the laquer, as was before observed, may be the same.

*Of staining wood yellow.*] Take any white wood, and



brush it over several times with the tincture of turmeric root, made by putting an ounce of the turmeric ground to powder, to a pint of spirit; and, after they have stood some days, straining off the tincture. If the yellow colour be desired to have a redder cast, a little dragon's blood must be added, in the proportion that will produce the tint required. A cheaper, but less strong and bright yellow, may be given to the wood, by rubbing it over several times with the tincture of the French berries, made boiling hot. After the wood is again dry, it should be brushed over with a weak alum water used cold. Lesser pieces of wood, instead of being brushed over with them, may be soaked in the decoctions or tinctures. Wood may be also stained yellow by means of *aqua fortis*; which will sometimes produce a very beautiful yellow colour, but at other times a browner. The wood should be warm, when the *aqua fortis* is laid on; and be held to the fire immediately afterwards; and care must be taken, that either the *aqua fortis* be not too strong, or that it be sparingly used; otherwise a brown, sometimes even a blackish colour, may be the result. In order to render any of these stains more beautiful and durable, the wood should be brushed over after it is coloured; and then varnished by the seed lac varnish; or when desired to be very strong, and to take a high polish, with three or four coats of shell-lac varnish.

[*Of staining wood red.*] For a bright red stain for wood, make a strong infusion of Brasil in stale urine, or water impregnated with pearl ashes, in the proportion of an ounce to a gallon; to a gallon of either of which, the proportion of Brasil wood must be a pound: which being put to them, they must stand together two or three days, often stirring the mixture. With this infusion strained, and made boiling hot, brush over the wood to be stained, till it appear strongly coloured; then, while yet wet, brush it over with alum-water made in the proportion of two ounces of alum to a quart of water. For a less bright red, dissolve an ounce of dragon's blood in a pint of spirit of wine, and brush over the wood with the

tincture, till the stain appear to be as strong as is desired. But this is, in fact, rather laquering than staining. For a pink or rose red, add to a gallon of the above infusion of Brasil wood two additional ounces of the pearl ashes, and use it as was before directed : but it is necessary, in this case, to brush the wood over often with the alum-water. By increasing the proportion of pearl-ashes, the red may be rendered yet paler : but it is proper, when more than this quantity is added, to make the alum-water stronger. These reds, when it is necessary, may be varnished as the yellows.

*Of staining wood blue.*] Wood may be stained blue, by means either of copper or indigo : but the first will afford a brighter colour ; and is more generally practicable than the latter. Because the indigo can be used only in that state to which it is brought by the manner of preparation used by the dyers : of whom indeed it must be had, as it cannot be properly so prepared but in large quantities, and with a particular apparatus. The method of staining blue with the copper is therefore as follows :—“ Take a solution of copper, and brush it, while hot, several times over the wood. Then make a solution of pearl-ashes, in the proportion of two ounces to a pint of water ; and brush it hot over the wood, stained with the solution of copper, till it be of a perfectly blue colour.” Wood stained green as above by verdigrise, may likewise be made blue, by using the solution of the pearl ashes in the same manner. When indigo is used for staining wood blue, it must be managed thus :—“ Take indigo prepared with soap lees as when used by the dyers ; and brush the wood with it boiling hot. Prepare then a solution of white tartar, or cream of tartar, which is to be made, by boiling three ounces of the tartar, or cream, in a quart of water : and with this solution, used copiously, brush over the wood before the moisture of the tincture of indigo be quite dried out of it.”—These blues must be brushed and varnished as the reds, where there is occasion.

*Of staining wood of mahogany colour.*] Mahogany colour is the most useful of any stain for wood (especi-

ally since the veneering with different colours is out of fashion) as it is much practised at present for chairs and other furniture made in imitation of mahogany; which, when well managed, may be brought to a very near resemblance. This stain may be of different hues, as the natural wood varies greatly, being of all the intermediate tints betwixt the red brown and purple brown, according to the age, or sometimes the original nature of different pieces. For the light red brown, use a decoction of madder and fustic wood, ground in water; the proportion may be half a pound of madder, and a quarter of a pound of fustic, to a gallon: or in default of fustic, an ounce of the yellow berries may be used. This must be brushed over the wood to be stained, while boiling hot, till the due colour be obtained; and, if the wood be kindly grained, it will have greatly the appearance of new mahogany. The same effect nearly may be produced by the tincture of dragon's blood and turmeric root, in spirit of wine: by increasing or diminishing the proportion of each of which ingredients, the brown stain may be varied to a more red or yellow cast at pleasure. This succeeds better upon wood, which has already some tinge of brown, than upon whiter. For the dark mahogany, take the infusion of madder made as above, except the exchanging the fustic for two ounces of logwood: and when the wood to be stained has been several times brushed over, and is again dry, it must be slightly brushed over with water in which pearl-ashes have been dissolved, in the proportion of about a quarter of an ounce to a quart. Any stains of the intermediate colours may be made, by mixing these ingredients, or varying the proportion of them. Where these stains are used for better kind of work, the wood should be afterwards varnished with three or four coats of seed lac varnish; but for coarser work, the varnish of resin and seed lac may be employed, or they may be only well rubbed over with drying oil.

*Of staining wood green.*] Dissolve verdigrise in vinegar, or crystals of verdigrise in water; and, with

the hot solution, brush over the wood till it be duly stained. This may be brushed and varnished as the above.

*Of staining wood purple.*] Brush the wood to be stained several times with a strong decoction of logwood and Brasil, made in the proportion of one pound of the logwood and a quarter of a pound of the Brasil, to a gallon of water; and boiled for an hour or more. When the wood has been brushed over there will be a sufficient body of colour, let it dry; and then be slightly passed over by a solution of one drachm of pearl-ashes in a quart of water. This solution must be carefully used, as it will gradually change the colour from a brown red, which it will be originally found to be, to a dark blue purple; and therefore its effect must be restrained to the due point for producing the colour desired. This may be varnished as the rest.

*Of staining wood black.*] Brush the wood several times with the hot decoction of logwood made as above; but without the Brasil. Then having prepared an infusion of galls, by putting a quarter of a pound of powdered galls to two quarts of water, and setting them in the sunshine, or any other gentle heat, for three or four days, brush the wood three or four times over with it; and then pass over it again, while yet wet, with a solution of green vitriol in water, in the proportion of two ounces to a quart. The above is the cheapest method: but a very fine black may be produced, by brushing the wood several times over with a solution of copper in *aqua fortis*; and afterwards with the decoction of logwood, which must be repeated till the colour be of a sufficient force; and the greenness produced by the solution of the copper, wholly overcome. These blacks may be varnished as the colours. — Where the stains are desired to be very strong, as in the case of wood intended to be used for veneering, it is in general necessary, they should be soaked, and not brushed; to render which the more practicable, the wood may be previously slit or sawed into pieces of a proper thickness for inlaying. It is to be understood



also, that when the wood is above ordered to be brushed several times over with the tinging substances, it should be suffered to dry betwixt each time.

*Of staining ivory, bone, or horn, yellow.]* Boil them first in a solution of alum, in the proportion of one pound to two quarts of water: and then prepare a tincture of the French berries, by boiling half a pound of the berries, pounded, in a gallon of water with a quarter of a pound of pearl-ashes. After this tincture has boiled about an hour, put the ivory, &c. previously boiled in the alum water, into it; and let them remain there half an hour. If turmeric root be used instead of the French berries, a brighter yellow may be obtained; but the ivory, &c. must in that case be again dipped in alum-water after it is taken out of the tincture; otherwise an orange colour, not a yellow, will be produced from the effect of the pearl-ashes on the turmeric.

*Of staining ivory, bone and horn, green.]* They must be boiled in a solution of verdigrise in vinegar; or of copper in *aquafortis*, prepared as above directed, (a vessel of glass or earthen ware being employed for this purpose) till they be of the colour desired.

*Of staining ivory, bone and horn, red.]* Take strong lime water, prepared as for other purposes; and the raspings of Brasil wood, in the proportion of half a pound to a gallon. Let them boil for an hour; and then put in the ivory, &c. prepared by boiling in alum water in the manner above directed for the yellow; and continue it there till it be sufficiently coloured. If it be too crimson, or verge towards the purple, it may be rendered more scarlet, by dipping again in the alum water.

*Of staining ivory, bone and horn, blue.]* Stain the ivory, &c. first green, according to the manner above directed; and then dip it in a solution of pearl-ashes made strong and boiling hot; but it must not be continued longer, nor dipped oftener than is necessary to convert the green to blue. The ivory, &c. may otherwise be boiled in the tincture of indigo prepared as by



the dyers; and afterwards in the solution of tartar made as is directed for the staining wood.

*Of staining ivory, bone and horn, purple.*] Treat them in the same manner as was directed for red; except that logwood must be substituted in the place of Brasil wood; and the use of the alum water must be omitted wholly. If a redder purple be wanted, a mixture of the logwood and Brasil must be employed, instead of the logwood alone. The proportion may be equal parts; or any less proportion of the Brasil, according to the colour desired.

*Of staining horn to imitate tortoise shell.*] The horn to be stained must be first pressed into proper plates or scales, or other flat form. The following mixture must then be prepared—"Take of quicklime two parts, and of litharge one; and temper them to the consistence of a soft paste with soap lye."—Put this paste over all the parts of the horn, except such as are proper to be left transparent, in order to the greater resemblance of the tortoise-shell. The horn must then remain thus covered with the paste till it be thoroughly dry: when the paste being brushed off, the horn will be found partly opaque, and partly transparent, in the manner of tortoise shell; and when put over a foil, of the kind of latten called *assidue*, will be scarcely distinguishable from it. It requires some degree of fancy, and judgment, to dispose of the paste in such a manner, as to form a variety of transparent parts of different magnitude and figure, to look like the effect of nature; and it will be an improvement to add semi-transparent parts. This may be done by mixing whiting with some of the paste to weaken its operation in particular places; by which spots of a reddish brown will be produced; that, if properly interspersed, especially on the edges of the dark parts, will greatly increase as well the beauty of the work, as its similitude with the real tortoise shell.

*To stain ivory, bone and horn, black.*] Proceed in the same manner as is above directed for wood.

*To stain paper or parchment, yellow.*] Paper may

be stained yellow by the tincture of French berries; but a much more beautiful colour may be obtained by using the tincture of turmeric formed by infusing an ounce or more of the root powdered in a pint of spirit of wine. This may be made to give any teint of yellow, from the lightest straw to the full colour, called French yellow; and will be equal in brightness even to the best dyed silks. If yellow be wanted of a warmer or redder cast, annatto, or dragon's blood, must be added to the tincture. The best manner of using these and the following tinctures, is to spread them even on the paper or parchment by means of a broad brush in the manner of varnishing.

*Of staining paper or parchment, red.]* Paper or parchment, may be stained red, by treating it in the same manner as is directed for wood, p. 56; or by red ink. It may also be stained of a scarlet hue by the tincture of dragon's blood in spirit of wine: but this will not be bright. A very fine crimson stain may be given to paper, by a tincture of the Indian lake, which may be made, by infusing the lake some days in spirit of wine; and then pouring off the tincture from the dregs.

*Of staining paper or parchment, green.]* Paper or parchment, may be stained green, by the solution of verdigrise in vinegar; or by the crystals of verdigrise dissolved in water. As also by the solution of copper in *aquafortis* made by adding filings of copper gradually to the *aquafortis* till no ebullition ensues: or spirit of salt may be used in the place of the *aquafortis*.

*Of staining paper or parchment, blue.]* A blue colour may be given to paper or parchment, by staining it green by any of the above-mentioned methods; and treating it afterwards as is directed for the staining wood blue, by the same means, or by indigo, in the manner there explained likewise.

*Of staining paper or parchment, orange.]* Stain the paper or parchment, first of a full yellow, by means of the tincture of turmeric, as above directed. Then brush it over with a solution of fixed alkaline salt, made by dissolving half an ounce of pearl ashes, or salt of tartar, in a quart of water, and filtering the solution.

*Of staining paper or parchment purple.]* Paper or parchment, may be stained purple by archais: or by the tincture of logwood, according to the method above directed for staining wood. The juice of ripe privet-berries expressed, will likewise give a purple dye to paper or parchment.

*Of staining alabaster, marble, and other stones, of various colours.]* Alabaster, marble, and other stones, may be stained of a yellow, red, green, blue, purple, black, or any of the compound colours, by the means above given for staining wood. But it is better, when a strong tinge is wanted, to pour the tincture, if made in water, boiling hot on the alabaster, &c. spreading it equally on every part, then to brush it over only; though that may be sufficient where a slighter dye will suffice. When tinctures in spirit of wine are used, they must not be heated; as the spirit would evaporate, and leave the tinging gums in an undissolved state. Where stones are not perfectly white, but partake of brownness or greyness, the colour produced by the tinges will be proportionably wanting in brightness. Because the natural colour of the stone is not hid or covered by these tinges; but combines with them: and, for the same reason, if the stone be of any of the pure colours, the result will be a compound of such colour and that of the tinge.

*Of the method of preparing and colouring marbled paper.]* There are several kinds of marbled paper; but the principal difference of them lies, in the forms in which the colours are laid on the ground: some being disposed in whirls or circumvolutions; some in waving jagged lengths; and others only in spots of a roundish or oval figure. The general manner of managing each kind is, nevertheless, the same: being the dipping the paper in a solution of gum dragacanth (or, as it is commonly called, gum dragon); over which the colours, previously prepared with ox-gall and spirit of wine, are first spread. The peculiar apparatus necessary for this purpose is, a trough for containing the gum dragacanth and the colours; a comb or quill for disposing them in

the figure usually chosen; and a burnishing stone for polishing the paper. The trough may be of any kind of wood: and must be somewhat larger than the sheets of paper, for marbling which it is to be employed: but the sides of it need only rise about two inches above the bottom: for, by making it thus shallow, a less quantity of the solution of the gum will serve to fill it. The comb may be also of wood, and five inches in length: but should have brass teeth, which may be about two inches long, and placed at about a quarter of an inch distance from each other. The burnishing stone may be of jasper, or agate: but as those stones are very dear, when of sufficient largeness, marble or glass may be used, provided their surface be polished to a great degree of smoothness. These implements being prepared, the solution of gum dragacanth must be made, by putting a sufficient proportion of the gum, which should be white, and clear from all foulnesses, into clean water; and letting it remain there a day or two; frequently breaking the lumps and stirring it, till the whole shall appear dissolved, and equally mixed with the water. The consistence of the solution should be nearly that of strong gum water, used in miniature painting: and, if it appear thicker, water must be added; or, if thinner, more of the gum. When the solution is thus brought to a due state, it must be passed through a linen cloth, and being then put into the trough, it will be ready to receive the colours. The colours employed for red are carmine, lake, rose-pink, vermilion and red-lead: but the two last are too hard and glaring; unless they be mixed with rose pink, or lake, to bring them to a softer cast: and with respect to the carmine and lake, they are too dear for common purposes;—for blue, Prussian blue and verditer, may be used:—for yellow, Dutch pink and yellow ochre, may be employed:—for green, verdigrise, a mixture of Dutch pink and Prussian blue, or verditer, in different proportions:—for orange, the orange lake, or a mixture of vermilion, or red-lead, with Dutch pink:—for purple, rose-pink and Prussian blue. These several colours

should be ground with spirit of wine, till they be of a proper fineness ; and then at the time of using them, a little fish gall, or, in default of it, the gall of a beast should be added, by grinding them over again with it. The proper proportion of the gall must be found by trying them ; for there must be just so much as will suffer the spots of colour, when sprinkled on the solution of the gum dragacanth, to join together, without intermixing or running into each other. When every thing is thus prepared, the solution of the gum dragacanth must be poured into the trough ; and the colours, being in a separate pot, with a pencil appropriated to each, must be sprinkled on the surface of the solution, by shaking the pencil, charged with its proper colour, over it : and this must be done with the several kinds of colour desired, till the surface be wholly covered. Where the marbling is proposed to be in spots of a simple form, nothing more is necessary : but where the whirls or snail shell figures are wanted, they must be made by means of a goose quill ; which must be put among the spots to turn them about, till the effect be produced. The waving jagged lengths must be made by means of the comb above described, which must be passed through the colours from one end of the trough to the other ; and will give them that appearance. But if they be desired to be pointed both ways, the comb must be again passed through the trough in a contrary direction ; or if some of the whirls or snail shell figures be required to be added, they may be yet made by the means before directed. The paper should be previously prepared for receiving the colours, by dipping it over night in water ; and laying the sheets on each other, with a weight over them, in the case of paper to be imprinted by copper plates. The whole being thus ready, the paper must be held by two corners, and laid in the most gentle and even manner on the solution covered with the colours ; and there softly pressed with the hand, that it may bear every where on the solution. After which, it must be raised and taken off with the same care ; and then hung to dry across a proper cord, sus-



pended near at hand for that purpose : and in that state it must continue, till it be perfectly dry. It then remains only to give the paper a proper polish ; in order to which it is first rubbed with a little soap ; and then must be thoroughly smoothed by the glass polishers, such as are used for linen, and called the calender glassess. After which it should be again rubbed by a burnisher of jasper or agate, or, in default of them, of glass ground to the highest polish : for on the perfect polish of the paper depends in a great degree its beauty and value. Gold or silver powders may be used, where desired, along with the colours ; and require only the same treatment as them : except that they must be first tempered with gum water.

*The original recipe for the making Prussian blue, as published by Dr. Woodward.*] “ Take any quantity of blood, and evaporate it to dryness ; continuing the heat till it becomes black ; but avoiding the burning any part of it to ashes. Powder the dry matter, and mix it thoroughly with an equal weight of pearl ashes ; and calcine the mixture in an iron pot or crucible, on which a cover is put. The calcination must be continued so long as the matter emits any flame ; the fire being raised to a considerable degree of heat at the end of the operation ; and the matter must be then powdered ; and put, while yet hot, into twelve times its weight of water ; which must be again set on the fire to boil for the space of three quarters of an hour, or more. The fluid must then be filtered off through a thin flannel bag, from the part remaining undissolved : through which remaining part fresh water should be passed, before it be taken out of the filtering bag, to extract as much as possible of the solution : and the water thus passed through should be added to the quantity before filtered : after which, what is retained in the bag may be thrown away. In the mean time a solution should be made of alum, and copperas calcined to whiteness, in the proportion of two pounds of the alum, and two ounces of the calcined vitriol, to each pound of the pearl ashes used with the blood, which so-

lution must be made by boiling the alum and copperas in five times their weight of water, and then filtering them through flannel or paper, where great nicety is required. When the solution of the alum and copperas is thus prepared; it must be added to the lixivium filtered off from the calcined blood and pearl-ashes; from which mixture, the precipitation of a blackish green matter will soon ensue. After the precipitated matter has subsided to the bottom of the vessel, and the fluid appears clear over it, separate it from the green sediment, first by pouring off all that will run clear out of the vessel, and afterwards by straining off the remainder; and then put the green matter again into a vessel, that will contain as much fluid as it was before mixed with. Add spirit of salt to it afterwards, in the proportion of six ounces to every pound of the pearl-ashes used; and the green matter will then soon appear to be converted into a beautiful blue. Water must then be added, to wash off the spirit of salt; which must be renewed several times, till it come off perfectly sweet; and the last quantity must then be strained off; and the blue sediment dried in lumps of a moderate size. The produce will be about three ounces for every pound of the pearl-ashes employed." — If the produce be desired to be made either of a lighter or darker hue, it may be done by increasing the proportion of the pearl-ashes to the blood, to give a lighter kind; or the spirit of salt to the pearl-ashes, to give a deeper kind: but the quantity will in the latter case be proportionably diminished. The straining or filtering the lixivium through flannel is not so good a method as the doing it thro' paper; especially where the colour is wanted of a very great brightness and purity; and the water is best separated from the great sediment first produced, and afterwards from the blue one, by the same means: but in these cases a fine linen cloth much worn, though whole, should be laid over the paper. The colour, when reduced to a proper consistence, may be laid on chalk stouts to dry: and a moderate heat may be also used for greater expedition, when required; but great care

should be taken not to burn the matter. The calcination may be performed in a reverberatory furnace, such as is used by the chemists; or in the furnaces where metals are melted; for the crucible or pot, containing the matter, may either be surrounded by the coals, or placed over them, provided a sufficient heat be given to it. But where larger quantities are to be calcined, they may be very cheaply and commodiously managed in the potters or the tobacco-pipe-makers furnaces; being put into them along with the earthen-ware and pipes.

*The English Fifty Pounds Premium Receipt for either taking or destroying Rats, or Mice, without Poison.]* There is no better place of security to decoy these vermin into than a large round wire cage, made in form of the common mouse traps, about sixteen inches wide, with several places for entrance: those for receiving mice should be much smaller, and so should the holes they enter at. It will be necessary, first, to observe the places they most frequent, and to discover the holes they make for passing and repassing. The traps are to be set within four or five yards of these holes, and from which, quite to those traps, the floor is to be rubbed (in a strait line about four inches wide) with a piece of strong rich cheese toasted, on which a few drops of oil of anniseed has been dropped, and the trap should be well rubbed likewise. *Baits for the traps are to be made thus:* Of strong cheese eight ounces; oatmeal the like quantity; seven or eight drops of oil of anniseed; Indian berries one ounce; featherfew half an ounce; droppings of sweet oil sufficient to make it up into a paitte: then form it into many little balls, and this will most assuredly decoy them into the cage, though many people were present. I advise the use of traps, otherwise they would retire to their private haunts, and expire, which would prove very offensive for some time to all near them, especially in warm weather.

*The following is likewise by a Candidate for the Fifty Pounds Premium.]* Procure an earthen vessel, well glazed in the inside, near two feet high, and full one broad

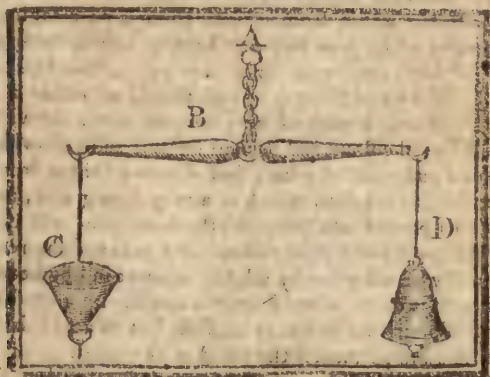
fill it to the middle with water, and hang a very smooth board to the top by two strong pins, and so even that the least weight will trip it up on either side; this board is to be well daubed over with the greasy composition before mentioned, (only he leaves out the featherfew) which entices the vermin on the board, and that slides them into the water, from whence there is no escaping.

*Discovery of the true reason of burning sulphur in hogshheads for preserving wine, by a new and curious experiment.*] If two or three drops of the oil of tartar are poured into half a glass of very fine red wine, the wine will lose its red colour, and become opaque and yellowish, as turned and pricked wine; but if two or three drops of the spirit of sulphur, which is a very strong acid, are afterwards poured into the glass, the same wine will entirely resume its beautiful red colour; whence the reason is easily perceived, why sulphur is burnt in hogshheads in order to preserve wine, since it is not the inflammable part of sulphur that causes this effect, but its acid spirit, that enters and permeates the wood of the vessel.

*The manner of silvering Looking-glasses, as done in London and Birmingham.*] First spread a paper on an even board or stone (a stone is best) on that sprinkle a little fine chalk, over which lay the leaf of tin: then dip a piece of cotton in quicksilver, and rub gently over the tin leaf (where the glass is to cover) till it looks bright. You are now to pour on the quicksilver as long as it will lie. Lay slips of paper, three double on each side, to support the glass, and then gently move it forward, keeping your hand pressing on it, to force out the superfluous quicksilver; let it be removed to another flat board, or stone, or lay a weight on it on the same, and in a day or two it will be dry. Note, for large plate glasses, a screw answers much better than a weight laid on.

*For softening Crystal.*] It must be left some time in the milk of a goat which has been made to feed during forty six days on ivy leaves. The use of this milk has been proved to be of singular service to those troubled with the gravel.

*The useful Alarm-Bell.*] This is originally a Dutch invention, and by which a person may be enabled to rise at any time of the night; or know how time goes as well as by a clock, or watch, by observing the following directions.



A is a small chain in the middle of a beam, and by which it hangs. B is a kind of a beam, like those belonging to scales. C a vessel made of either glass or tin, in the form described, which is to be filled with fine dry sand, the quantity to be more or less, according to the time you would rise: the vessel C is to have a small hole at the bottom, as in an hour glass, thro' which the sand is to pass. D is along at the opposite end of the beam B. When the vessel C is empty, the bell D is to be a very little heavier than C, by which means, after the sand is all discharged, the bell D becoming more weighty than C, the ballance instantly falls on that side, and the bell continues ringing for some time, and by which noise the person is called at the time required. The way to proportion the sand to the time is thus: Suppose a person required to be called in four hours after going to rest: if, on trial, half a pound of sand will run four hours, then that is to be the quantity; if in six hours, then



12 ounces are to be put into the vessel; if in eight hours, one pound, and so in proportion to the time it is to run.

*For softening Ivory and Bones.*] Take sage, boil it in strong vinegar, strain the decoction through a piece of close cloth; and, when you have a mind to soften bones or ivory, steep them in this liquor, and the longer they remain in it, the softer they will grow.

*Another preparation for softening bones.*] Take roman-vitriol and common salt, of each one pound; bruise and reduce them into an impalpable powder; put them into an alembic: the distilled water will have the virtue of softening bones; and, to succeed therein, they need only be left to steep in it for half a day.

*For softening glass.*] Take the blood of a he-goat and a duck, some dregs of oil and vinegar; mix these things together, and put them into a varnished earthen pot: let the whole be warmed a little, and afterwards, having put some glass in, let it there remain till it becomes soft.

*A ready way for melting iron.*] Take sulphur, mix it with a little salt, and dilute the mixture with a child's urine, till it becomes white: besmear the iron with it, and you will soon see it liquefy. As to the more compact and harder metals, fire alone can make them liquefy.

*The virtues of Succinum.*] Mizaldus says, that fastened about the neck, it radically and surprisngly cures the fistula lachrymalis and soreness of the eyes. A woman of Copenhagen, being tormented with a continual pain of the head, was advised to wear an amber necklace, whereupon the pain soon vanished. This induced her to leave it off but seldom, and only when she was apprehensive it caused too great a dryness, by dissipating too great a quantity of her humours. This observation is supported by that of Caspard Scholler, a magistrate of the same city, who is lavish of his commendations of succinum, having himself found very good effects by it.

*A remarkable circumstance concerning ale; with an unerring method of brewing malt liquor, that will soon be fine and fit for drinking; and far more palatable and*

*wholesome than what is procured from the too common erroneous way many brewers follow.]* Whoever brews and expects to have either good ale or beer, will be sure to be disappointed, if care is not taken to provide good malt and hops ; nor is the water made use of so very immaterial an article as some imagine, for a great deal depends upon it. What I have above advanced may very likely be credited by many ; but when I come to tell them, there is more malt liquor spoiled by high boiling, than by all mismanagements put together, it is easy to perceive I shall have many obstinate infatuated people to encounter with, who very simply imagine that ale or beer, cannot possibly be bad which has had a four hours boiling. It is well known there are many parts of England remarkable for fine malt liquors ; and I as well know, that not one of the counties that have excelled in either ale or beer, ever boiled above half an hour at most. There is, indeed, a town in Devonshire that is said to have constantly good ale. I am well acquainted with it ; Barnstable, no doubt, has a strong glutinous ale, that pleases many people ; and those who brew, I dare say, most scandalously boil it, at least four hours. But what is the consequence ? Why there is scarce a house in that place but affords a pair or two of crutches, and unhappy cripples to make use of them. I must own people in England have not followed this pernicious custom so much of late years. They find they are gainers by their reformation ; and many have owned, they never had such valuable ale or beer, as since they left off the old mistaken way of boiling for three or four hours, and acknowledge they have reduced it to less than a quarter of that time. There are others again, who declare, to their customers, that they actually boil four hours : when in fact, a quarter of an hour is the most they have boiled for five or six years past. I believe this reformation is chiefly owing to some treatises published concerning brewing, in which the pernicious consequence of high boiling is sufficiently displayed and exploded. I will beg leave to give an instance of the bad consequences of long boiling, that

will be sufficient to satisfy any person who practises it, of their error. A gentleman of my acquaintance, in Chester, often complained to me, that he bought the best of malt and hops ; that they had fine water from the river Dee, and he had it constantly boiled full four hours ; and yet notwithstanding all this, he could not have either good ale or beer. His lady too joined in the complaint, and said, it would be a great satisfaction if a remedy could be found, as many of the gentlemen who visited there preferred a glass of fine beer to any liquor whatever. I then told him, if he would have a brewing after my direction, I would be answerable, that it would prove satisfactory. Accordingly good malt and hops were provided, and the water was fetched from the river Dee, as usual. I must own it was with the utmost difficulty I prevailed on the man who brewed to boil it so short a time, who protested it would be good for nothing. However, I at length prevailed, and he proceeded in the following manner : the quantity of liquor was sixty gallons ; and to put the thing quite out of dispute, and to prove that boiling long was erroneous, the first twenty gallons were boiled twenty six minutes ; the second twenty gallons one hour and a quarter : and the third and last twenty gallons full two hours. In about a month, the three casks were examined : that which was boiled twenty-six minutes, proved extremely fine and well tasted, and gave a general satisfaction. But the cask which contained the liquor of the second boiling, was very far from being either so fine or pleasant. And the third cask which contained the last and long boiled liquor, proved very foul, and quite disagreeable in many other respects. Now as there was no difference in the management of the sixty gallons of ale I have been speaking of, boiling only excepted, how will the advocates for long boiling malt liquors account for this : the same malt, hops and water, tunned at the same time, and in casks of the same size, and placed in the same good cellar. I have to add to this account, that at the two months end, the second boiling was foul and ill tasted, and was

made fine with great difficulty. The last boiling was very foul and bad ; at the end of six months it was cloudy, ropy, and ill tasted ; some attempts were made in vain, to fine it ; but at about ten months old, it was far worse. The gentleman, who, indeed, was too fond of long boiling, for many years before, as it had been often insinuated to him, that drink could not be boiled too much, was greatly pleased to find the first cask prove so exceeding good, with little boiling ; he then gave orders to the man who brewed for him, never for the future, to boil his liquor above twenty minutes, which directions were strictly observed : and it is now as uncommon to find any malt liquor that is bad in his cellars, as it was before to have any that was good. I would fain know what it is boiled for the length of four hours ? Some tell you, 'tis to get the goodness out of the hops. To which I answer, it is a sad thing so many thousand gallons of malt liquor should be spoiled every year, only to get goodness (as they are pleased to call it) out of the hops, when many other means might be used to do it in a few minutes. In one word, the long boiling malt-liquor has many bad properties attending it, without having any thing in its favour : for it renders such ale too gummy and stey to be wholesome, and is the cause of many becoming cripples, who make a too frequent use of those pernicious long boiled liquors : for the blood, by this means, becomes too glutinous to pass the fine blood vessels : hence arise those various disorders ! those pains ! those aches ! that render the unhappy cripples not only a fatigue to themselves, but introduce disorders that are felt by future generations. Nor does the mischief stop here (though I must own this is the most melancholy part of it) for whenever such ale or beer proves foul, which is too commonly the case, it is with great difficulty made fine, and fit for drinking. In short, those who once experience the great advantage that will result from boiling their liquor not longer than twenty-five or thirty minutes, will be sure to have this satisfaction, that their ale will be much better, plea-

santer, and more wholesome, than those that are long boiled ; by which they will not only preserve the health of those who drink it, but also have more liquor from the same quantity of malt ; which very likely may be a means of prevailing, as interest is in the case, more than any other arguments. It is to be remarked that all liquor should be boiled as nimbly as possible (so as not to make it run out of the boiler) and also that the long stupid way of boiling for the goodness of the hop, is of the utmost prejudice ; for its fine flavour will be soon extracted : what comes after, by length of stewing, is only an earthy, heavy, pernicious quality, that will be sure to render the ale disagreeable, and prove prejudicial to those who drink it. — Thus much I have presumed to say, in order to prevent the pernicious custom, that has too long prevailed : persons of reason will very likely try the experiment : 'tis on those I rely and on whom it will chiefly depend to decide, which method is best to pursue, that guided by reason, long experience, and the result of many years practice ; or the method obstinately pursued by unreasonable bigots, and a set of infatuated old women.

*The benefits arising from drinking Tar-water.*] Tar-water has been lately recommended to the world as a certain, safe, and almost infallible medicine in almost all diseases ; a slow, yet effectual alterative in cachexies, scurvy, chlorotic, hysterical, hypochondrical, and other chronic complaints : and a sudden remedy in acute distempers which demand immediate relief, as pleurifies, peripneumonies, the small pox, and all kinds of fevers in general : yet, though it may fall short, in some cases, of the character given it ; it is, doubtless, in a multitude of cases, of great utility : it sensibly raises the pulse, and occasions some considerable evacuations, generally by perspiration, or urine, though sometimes by stool or vomit ; hence it is supposed to act by increasing the vis vitæ, and enabling nature to expel the morbid humours. We shall here insert, from the first public recommender of this liquor (Bishop Berkeley) some observations on the manner of using it. Tar-water, when right, is



not paler than French, nor deeper coloured than Spanish white wine, and full as clear: if there be not a spirit very sensibly perceived in drinking, you may conclude the tar-water is not good. It may be drank either cold or warm; in cholicks, I take it to be best warm. As to the quantity in common chronical dispositions, a pint a day may be sufficient, taken on an empty stomach, at two, or four times, to wit, night and morning, and about two hours after dinner and breakfast: more may be taken by strong stomachs. But those who labour under great and inveterate maladies, must drink a greater quantity; at least a quart every twenty four hours; all of this class must have much patience and perseverance in the use of this, as well as of all other medicines, which, though sure, must yet, in the nature of things, be slow in the cure of inveterate chronical disorders. In acute cases, fevers of all kinds, it must be drank in bed warm, and in great quantity, (the fever still enabling the patient to drink) perhaps a pint every hour, which I have known to work surprising cures. But it works so quick and gives such spirits, that the patients often think themselves cured, before the fever hath quite left them.

*Bishop BERKLEY's manner of preparing Tar-water.]* Tar, two pounds; water, one gallon. Stir them strongly together with a wooden rod: and after standing to settle for two days, pour off the water for use. It must be acknowledged the tar water prepared after the directions here given, has done great service in the multitude of disorders, after many other medicines had been tried, to very little purpose: particularly in the small-pox, fevers, scurvy, &c. though of the most inveterate kind.

*How to take off superfluous hair.]* This is often advertised in the news-papers, and is sold at so high a price, that a person has acquired a fortune by the sale of it; the preparation is both easy and cheap, being only quick-lime and orpiment, made into a paste with common river water; but those who use this composition,

ought to be cautious how they put it on the part, and not suffer it to remain above a minute or two.

*To turn acid Cider into Vinegar.*] Cream of tartar half a pound, boil it in a quart of strong white wine vinegar, and put it hot into twenty gallons of cider, which you are to set in the sun a few days, and it will be excellent vinegar. The bung must be off.

*To make Vinegar of Beer.*] Boil a quart of sharp beer-vinegar about eight minutes; take off the scum, and put therein two ounces of bay-salt, four of cream of tartar, and two of alum; then put it to twenty gallons of beer, and let it stand in the hot sun as the cider is directed.

*The celebrated Bath Liquid for taking out Spots, Stains, &c.*] Put half a pound of soap boiler's ashes into three pints of river water; let it stand four days (often stirring it), then pour off the clear water, and mix it, as you use it, with fuller's earth, in which a few drops of spirits of turpentine have been mixed: this you are to lay hot on the place, and it will surely take out either spot or stain.

*To clean Jewels, Pearl, &c.*] There is nothing cleans any kind of jewels like fine smalt and emery mixed together. Rub them well with a fine soft brush dipped in the powder. Pearls are to be washed with a strong lee of burnt tartar.

*To boil up Plate, to look like new.*] Of unslacked lime and alum one pound each; beer grounds two quarts: boil the plate in these about a quarter of an hour.

*A safe and sure cure for an intermitting Fever.*] Drink plentifully of warm lemonade in the beginning of every fit, and in a few days the fever will cease. Or, take twenty grains of sal almoniac in a cup of tea, an hour or two before the fit comes on.

*How to prevent the smoaking of lamp oil.*] Soak your match, or cotton, in vinegar, and dry it well before you use it; it will then burn both sweet and pleasant, and give abundance of satisfaction for the trifling trouble you have in preparing it.

*How to make Homberg's black Phosphorus, which takes fire immediately on being exposed to the open air.*] This article, which may be made useful on sundry occasions, either at home, or abroad, is prepared with alum and wheat flour (five parts of the former to one of the latter) calcined together to a brownish, or black mass; which being powdered and set in a phial loosely stopp'd, in a sand heat, so as to continue glowing for some time; then removing the whole from the fire, and suffering it to cool gradually, and at last stopping the bottle close, it should be kept in a dark and dry place. A little of this powder being exposed to the open air, it at once takes fire, and appears like a glowing coal; and it is remarkable, that it may be made of any animal or vegetable substance, instead of wheat flour; but that no salt can be substituted instead of alum. This is very necessary in a family, as it constantly affords light on any occasion, day or night, when a tinder-box is not to be had.

*Another Phosphorus, by Mr. Homberg.*] This is made of one part of sal ammoniac, and two parts of lime, slacked in the air; mix these well together, and fill a small crucible with them: set this in a small fire of fusion, and as soon as the crucible is red hot, the mixture will melt, and should be stirred with an iron rod to prevent its running over. When the matter is entirely fused, pour it into a brass mortar, and, when cold, it will appear of a grey colour, and as if vitrified; if now it be struck upon with any hard body, it appears as on fire in the whole extent of the stroke; but the matter being brittle, it is proper, for the experiment's sake, to disperse bars of iron, or copper, in the melted matter in the crucible, for thus they will be enamelled as it were with the matter, and these bars being struck upon, will give the same fire, and the experiment may be several times repeated before all the matter falls off. These bars must be kept in a dry place, to prevent the phosphorus upon them from running, by the moisture of the air. Both these phosphori were discovered by accident; the first, in searching for a lim-

pid oil from the common stercoraceous matter that should fix quicksilver; and the second, by endeavouring to calcine sal ammoniac with lime, so as to render it fusible like wax: which end was obtained, but not the other.

*Phosphorus*, in physiology, is a denomination given to all bodies which shine, and seem to burn, without having any degree of heat: and that these bodies owe their lucidity to the motion of the parts, seems evident for the following reasons. 1. Several phosphori are undoubtedly owing to putrefaction, as rotten wood, very stale meat, especially veal, some sorts of fish long kept, as oysters, lobsters, flounders, whittings, &c. which putrefaction is the effect of a slow and gentle fermentation, or intestine motion of the parts. 2. Most phosphori have their light so weak as to shine only in the dark, which seems to argue a lesser degree of velocity in the parts than what is necessary to produce heat; because this last degree of velocity will cause bodies to shine in open day-light, 3. Some phosphori are the parts of animated bodies, as the cicindela or glow-worm; but all the parts of an animal are undoubtedly in motion. 4. Other phosphori put on the appearance of flame, as the ignis fatuus, the writing of common phosphorus made from urine, flashes of lightning, &c. but all flame is nothing but a kindled vapour, whose parts are all in motion, which may be too weak to cause burning, or even a sensible degree of heat. 5. Several of those innocent lambent flames may have their matter so agitated, or the velocity of their motion so increased, as actually to produce heat, and burn: thus, the writing of phosphorus on blue paper, sufficiently rubbed, will kindle into an ardent flame, and burn the paper. 6. Phosphori seem to have the essential nature of fire, because they are so easily susceptible of a burning quality from fire: thus, common phosphorus is immediately kindled into a most ardent and inextinguishable flame, by common fire. 7. By stroking the back of a black horse, or cat, in the dark, we produce innumerable scintillæ, or lucid sparks; in the same manner, the rubbing a

piece of black cloth, which has hung in the sun to dry, will cause it to throw out the particles of light which it had imbibed from the sun; whereas, a white piece of cloth, which reflects most of the sun's rays, emits no such lucid sparks in the dark. Many other reasons might be urged to show, that light of every kind is owing to one and the same cause in a greater or lesser degree, viz. the velocity of the parts of the lucid body. Phosphori in general says Lemerî, may be considered as so many sponges full of the matter of light, which is so slightly retained therein, that a small external force is sufficient to put it in motion, and cause it to exhale in a lucid form. Thus the phosphori is made of human urine, and other chemical preparations, receive so large a proportion of fire in their preparation, and retain it so well in their unctuous substance, that it may be kept there in water, for twenty years; so as upon the first laying them open to the air, they shall take fire, and exhale in lucid flames. Not that the fire is supposed to be fixed and quiescent all the while in the body of the phosphorus; for that it has a real motion all the time is evident hence, that it is seen in any dark place, in the summer season, fulminating and emitting flames (though, with all this, it scarce loses any thing of the fire) so that the fire is not fixed in the phosphorus, but in a continual undulatory motion. Chemistry, says Dr. Shaw, hath scarce afforded any thing more surprising than the common phosphorus. To see letters traced with this matter become luminous in the dark, images and the bodies of men to blaze with light, and abundance of the like experiments, performed by means of phosphorus, must awaken the curiosity of those who have seen these experiments, and render them desirous of being acquainted with the method of preparing it. The preparation, even to this day, is kept as a secret in few hands, and the matter sold at a very great price. — Whence we apprehend it would be no unacceptable present to the world, to render this commodity cheaper, and discover its further uses.



*The successful method of preparing the Phosphorus of urine is this.*] Evaporate any quantity of fresh urine over a gentle fire, to a black and almost dry substance; then with two pounds thereof, thoroughly mix twice its weight of fine sand; put this mixture into a strong coated stone long neck; and having poured a quart or two of clear water into a large receiver, join it to the long neck, and work it in a naked fire: let the heat be small for the first two hours; then increase it gradually to the utmost violence; and continue this for three or four hours successively: at the expiration of which time, there will pass into the receiver a little phlegm and volatile salt, much black and fœtid oil, and, lastly, the matter of phosphorus, in form of white clouds, which either stick to the sides of the receiver, like a fine yellow skin, or fall to the bottom in form of small sand. Now let the fire go out, but let the receiver continue till all be cold, lest the phosphorus take fire on the admission of the air. To reduce these small grains into one piece, put them into a little tin ingot-mould, with water; heat the ingot to make the grains melt together; then add cold water, till the matter is congealed into one solid stick, like bees-wax; which being cut into small pieces, fit to enter the mouth of a vial, may be preserved by water, and keeping the glass close stopped. If the glass were not to be stopped, the phosphorus would turn black on its surface, and at length be spoiled. The cautions required to make this process succeed, are, 1. To evaporate the urine, while it is recent. 2. To prevent its boiling over and by that means losing the most unctuous part. 3. To let the matter afterwards ferment in the cold. 4. To mix the black matter with the sand, to prevent its melting and running over. 5. To use a stone long neck, those of earth being too porous, and suffering the phosphorus to transude sooner than pass into the receiver. 6. To have the receiver very large, and with a very long neck, to prevent its breaking and overheating, which would either evaporate the white vapour wherein the phosphorus consists, or else prevent its co-

agulating. 7. To put water into the receiver, for keeping it cool, and quenching the phosphorus as it falls to the bottom. 8. To make the fire small at first, that the long neck may be preserved, and the black matter gradually dried; which would otherwise swell and run over in a black froth. 9. Lastly, it is found necessary, that the urine for the operation be such as drink malt liquors, rather than wine. All these circumstances being required for obtaining the phosphorus to advantage, it is no wonder that so many of those who attempted it, miscarried. This operation may be greatly shortened, by freezing and concentrating fresh urine; afterwards evaporating it with care; then digelling it in the manner above mentioned. When thoroughly digested, commit the matter, in a large quantity, to an iron pot, with an earthen head as the chemists usually do for making spirit of harts-horn, or the spirit and salt of urine: and when, by this method, all the salt and oil are obtained, let the caput mortuum be taken out, and mixed with twice its own weight of alum. The matter may now be put into well-coated long-necks, and worked with care in a reverberatory furnace, into large receivers filled with water, and connected to the long-necks by adopters, the lower ends whereof may enter the water, as in distilling of quicksilver; the operation being continued eight or ten hours. And this is apprehended to be the best way hitherto known of procuring phosphorus to advantage. This phosphorus has been several ways disguised, so as to make it appear under various forms; sometimes as a solid, sometimes as a liquid, sometimes as an ointment and sometimes as a running mercury. Dr Wall informs us, that Mr. Boyle, being concerned to find how small a proportion of phosphorus was afforded by urine, desired him to look out for another subject that might afford it in greater plenty. The doctor afterward causing a piece of dry matter to be dug up in the fields where night-men emptied their carts, he observed a great number of small particles of phosphorus therein. This matter the doctor immediately carried

to Mr. Boyle, who set Bilgar, the chemist, to work upon it; but he could obtain very little phosphorus from it, till another material was added to it in distillation; and then he procured phosphorus in such plenty, that, selling large quantities at six guineas the ounce, he soon became rich, and left England. The matter which thus fixes and increases the phosphorus is apprehended to be alum, which is itself not only in some measure prepared from urine, but appears to afford the same kind of acid that phosphorus yields by burning; for, upon its analysis, phosphorus appears to be a composition of a strong acid and inflammable matter, exactly in the manner of common brimstone, whence it may not improperly be called an animal sulphur: and accordingly, like common brimstone, it will burn under a glass bell, and afford flowers that become an acid liquor, like *oleum sulphuris per campanam*, by attracting the moisture of the air. This phosphorus has been employed for making curious experiments, a few whereof we shall here exhibit from Dr. Shaw.

1. The light of this phosphorus appears greater in vacuo than in the open air.
2. In hot weather it is observed to dart flashes of light through the water wherein it is contained, so as exactly to resemble lightning; which thus darts unextinguished through watry clouds and vapours.
3. These flashes of light are not apt to kindle or burn any combustible matter, in which they resemble the harmless kind of lightning; but in a condensed state this phosphorus burns very furiously, and with a most penetrating fire, so as to melt and dissolve metals; in which respect it again resembles the more destructive kinds of lightning, which are found to have the same effects.
4. If a little piece of this phosphorus be viewed through a microscope, the internal parts appear in a constant ebullition.
5. Though the phosphorus appears to be a kind of sulphur, yet it does not dissolve in highly rectified spirit of wine, but communicates some sulphureous parts thereto; for, if this spirit be poured into water in the dark, it yields a faint degree of light.
6. This phosphorus, being

mixed with a large quantity of pomatum, makes a shining unguent, which may be rubbed on the hands and face, without danger of burning, so as to render them luminous in the dark. Many other surprising experiments may be made with this phosphorus, which is a substance that seems in chemistry to be much such a thing as the loadstone in natural philosophy; and its effects almost as odd and difficult to explain, for want of knowing the latent properties of bodies.

*To make a varnish for Brass, that will cause it to look like Gold.*] Take two quarts of spirit of wine, and put them into a retort glass; then add to it an ounce of gumbuge, two ounces of lacca, and two ounces of mastic: set this in a sand-heat for six days, or else near a fire, or you may put the body of the bolt-head frequently into warm water, and shake it two or three times a day: then set it over a pan of warm saw dust. But before this varnish is laid over the metal, let it be well cleaned. This is a good varnish to mix with any colours that incline to red, and the amber-varnish for those that are pale.

*To make a varnish for any thing covered with Leaf Silver.*] First paint the thing over with size, and ground chalk or whiting; let them stand till they are thoroughly dry, and then do them over with very good gold size, of a bright colour (for there is much difference in the colour of it, some being yellow, and others almost white: the first is proper for gold, and the last for silver) when this size is so dry, as that it will just stick a little to the touch, lay on the leaf silver, and close it well to the fire.

THE  
GOLDEN CABINET:  
BEING THE  
LABORATORY,  
OR  
HANDMAID to the ARTS.  
CONTAINING  
*Such Branches of Useful Knowledge,*  
As nearly concerns all Kinds of People,  
From the SQUIRE to the PEASANT:  
AND WILL AFFORD BOTH  
PROFIT and DELIGHT.

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PART THE SECOND.

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PHILADELPHIA:  
PRINTED AND SOLD BY WILLIAM SPOTSWOOD,  
AND H. AND P. RICE, MARKET-STREET.





# THE SCHOOL of ARTS.

## PART THE SECOND.

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### *Of Drawing in General.*

OF all the polite arts, none have had so large a share of admirers as that of Drawing, the number of them including almost all mankind: and no wonder, since it represents objects to us in such pleasant resemblances, that we are apt to imagine we see things which we really do not. It likewise teaches us to imitate all the works of the Creation: it brings to our remembrance things long since past, the deeds of people and nations long since dead, and represents to us the features and resemblances of our ancestors for several generations. There are few arts or professions to which if drawing be not the parent, she must, at least, be acknowledged a kind of assistant; all designs and models being executed by drawing; mathematicians, architects, and navigators, daily practise it; it is used in most stations of life, from the general who commands an army, to the common mechanic. Nor have the ladies been less fond of this most excellent art; several of whom have acquired a great degree of perfection. The public are greatly obliged to Mrs. Mariana, as well as to Miss Smyth, and Miss St. Laurence: the

two last ladies have even excelled Heckel, in the flower way; and Mrs. Mariana's most surprising genius has excited our utmost admiration. To this lady we are remarkably obliged for the invention of a fine blue colour, little inferior to that of ultramarine (of which more will be said in its proper place) and only remark here, that I shall endeavour to find a colour to answer that of carmine; by which means those two extravagantly expensive articles will be less called for, and the worthy fraternity of colourmen have less to answer for; as they have for many years imposed, what they are pleased to call ultramarine on the public, at the very modest price of four, five, six or seven pounds per ounce; when, in fact, a better blue might have been produced for less than five shillings. And, indeed, much the same may be said of carmine; it generally sells from three to four pounds per ounce: I know the French carmine (which is the worst made use of) at this time fetches two guineas and half the ounce. I am sorry to say this last article is too often made an improper use of; which, indeed, occasions the great demand for it; and though the fair sex have spent many hours very agreeably in the polite art of painting; yet I cannot help observing, that it is the greatest absurdity to endeavour to mend the works of the Creator, by laying on a pernicious colour, that will very assuredly soon render the most beautiful object dull and disagreeable. But this is too tender a point to touch severely; and shall only add, in this place, the words of Shakspeare's Polonius;

*'Tis true, 'tis pity!—pity it is, 'tis true!* Humbly Hoping, that the ladies of North America will disdain European fashions; but, above all, abandon and abhor their vices\*.

*Rules to be observed in Drawing.*] Drawing is the representing, by lines or shades, the form or appear-

\* The Ladies in several parts of Europe are so fond of painting their faces, that it is even done publicly; the mother teaches her daughter this pernicious art; and the men do it as frequent as the women.

ance of any thing in nature or art, the imitation of another draught, or the expressing, by lines and shades, any designs conceived in the mind. And as in imitating nature, or any draught, the mind is first impressed with the form or shape of the figures; which by the operation of the hand, is afterwards expressed by lines, it will appear how necessary it is, that the mind should be frequently used in a curious observance of what is proposed to it, by which use it will conceive more fully and justly of objects, and the hand will delineate, with the greater ease and exactness, what is thus strongly imprest on the memory. In order to arrive at perfection, it is necessary to understand what is good and beautiful in a draught; in which knowledge the mind will make a quick progress, by comparing prints and draughts together. 'Tis a rock on which many painters have split, they have satisfied themselves with a bare imitation of bad pieces, without improving their genius, or acquiring a capacity to discover what are beauties, and what defects. Our ideas, in some measure, ought to serve us for a model, and if we would improve these, we must frequently view the performances of others; we ought to be nice and critical in observing such as are correct and good; we should meditate on every print and draught we see, make necessary reflections on them, and labour to fix in our minds a remembrance of their beauties, the freedom and boldness of the out-line, and the proportion of the several parts. If the judgment be well formed, the young practitioner will be enabled to make a much greater improvement than he can possibly do, if he proceeds in practice, without increasing in judgment. The labour of the hand must second and support that of the brain; 'tis impossible to become an able artist, without making the art habitual, and a perfect habit is not to be gained, without a great number of acts, and without constant practice. In all arts, the rules of them are to be learned in a short time; but the perfection of them is not acquired without practice and diligence. It is a true maxim, that laziness never produced any thing that was excellent; to be perfect

in drawing, 'tis necessary that the hand should be improved in practice, and the mind in judgment every day. Morning is the best and proper part of the day for business; employ it therefore in the study and exercise of those things which require the greatest pains and application. The first care should be employed in imitating straight and curved lines, square, round, regular, irregular, and inanimate figures, also parts or out-lines of flowers, &c. &c. This will be a good platform on which to erect the building; for by this labour you will attain a facility of hand, a freedom and exactness of drawing lines, and a customary exercise of patience; qualifications, without which no one can apply himself with pleasure and diligence in the exact imitation of the most difficult objects, which will require a longer time, and more art in copying. The circumferent strokes are called out-lines; and the excellency of a good out-line consists in freedom, boldness, and the exact proportion of all its parts. Always begin your copy at the top; and draw the right side of the figure first, for by that means the strokes are always exposed to the eye; the rest will follow more naturally, and give less trouble. Be content for some time, to practise after a good out-line, without attempting at finished pieces, or even without shading your own draught: sketch your out-line at first with slight touches, and faint, that the amendment of it, when necessary, may be the better performed, without appearing to be re-touched: endeavour after the most exact imitation in every stroke; and when you correct the out-line, by taking away a little of some parts, and swelling others, mind that you lose nothing in the freedom and boldness of it. Compare your copy frequently with the original, carefully observing what is amiss, that a fault may not escape you without correction, and that in the next draught you make after the same original, you may avoid those errors; for you are not to make new transitions from one original to another, till you have obtained in some measure a proficiency in the first. Many sketches of the same figure, in every one endeavouring



to exceed the former, is the surest way of practice. Be slow in your first operations; a constancy of practice will be sure to make your hand expeditious; learners must overcome their passions by the exercise of patience; they must proceed slowly and prudently in their first attempts, and make it their care rather to perform well, and to secure every stroke, and by that means make one good draught, than in a heedless manner to hurry over a number of bad ones. The same may be said with regard to most other arts. Before you begin your work, and whilst you are at it, view your original with close attention; divide it in your mind in several parts; observe the length, the breadth, and the similitude of each part; consider their proportion to each other, and to the whole; the distances from one part to the other, and what parts lie parallel to each other. After you have done your copy, and your mind perhaps been employed about other affairs, you should view them afresh, for many faults will then appear, that were not discovered before; and whatsoever pains you bestow on frequent reviewing and comparing the original with your own copy, will not only serve to perfect you in that particular draught, but will also improve you in the knowledge of lines, draughts, and proportions, and by practising in that method, you will be the sooner qualified for the more nice and nearest imitations. The out-lines must be drawn in a flowing, gliding manner, large and smooth, for when they are too straight, they appear stiff; but, when performed in the manner here directed, they have the resemblance of life and motion. What other instruments are necessary, will be found in the following pages; and shall now direct to the

*Proper Materials for Drawing.*] These are either black-lead pencils, or black-lead fixed in a portercayon, charcoal, red, black, or white chalk, pastils or crayons, pens, or hair-pencils, and Indian-ink. Black-lead is as proper, in the beginning, to practise after the plain lines, &c. as any other material: the stroke it makes being smooth, will be more pleasing than what is effected by charcoal or crayons. It must have a fine point, and

accustom yourself to hold it long in your hand, that the end of your fingers may be at a much greater distance from the point, than they are from the nip of a pen in writing, and form your strokes with light gentle touches, by which means you will obtain a greater command of hand, and your out-line will be more free and bold. Pens are sometimes used in shading draughts, by hatching them with cross strokes : but this is better done with hair pencils and Indian-ink, which is used in the same manner as water-colours. The shades in hatching are effected by lines, and appear like the strokes which shade an engraved print : but contrary to this, is using the hair-pencil and Indian-ink, there do not appear any lines, but the shades look like those in a mezzotinto print.

*Of Lights and Shadows.*] It is the artful management of lights and shades that gives the appearance of substance, roundness, and distance, to whatever bodies we represent. Imagine you draw a circle on a piece of paper ; consider this circle, when it is first formed, or fill it up with any even colour whatever, and it will appear to be a body with a round circumference, and flat sides : but, if you let the strongest of the colour remain in the middle, and gradually weaken it towards the circumference, it will, by this means, pleasingly deceive the sight, and receive a convex appearance like a ball or globe. Wherever the vivacity of colour is strongest, that part of the object catches the sight first, and appears nearest to it : whereas its weakness and goings off are more and more broken and faint, and seem to fly farther from the sight. In rounding the parts of any object, the extremities in turning must lose themselves insensibly and gradually, without precipitating the light all of a sudden into the shadows, or the shadows into the light ; but the passage of the one into the other must be easy and imperceptible ; that is, the shadow must be softened gradually, till it loses itself in light. Objects that are painted light, must have a sufficient breadth of shadow to sustain them ; and dark bodies must have a sudden light behind, to detach

them from the ground, or from those objects that are placed behind them, otherwise they will confusedly appear, as sticking upon each other; whereas the opposition of shade to a light object, and of light to a dark one, gives a projection, and separates them from other bodies. The nearer any object is to the eye, it is seen so much the stronger and plainer; the sight is weakened by distances; and the more remote any object is, 'tis seen in a more imperfect manner; therefore these objects that are placed foremost to the view, ought to be more finished than those that are cast behind; and they should have such a relative dominion over each other, that as the object, by its heightenings, causes others to retire more backward, so the same object must be chased, and made to appear farther from the sight, than others which are more strongly illuminated. It is not sufficient that remote objects be only coloured in a more faint and languid manner, but, according to their distance and parts, must appear more or less confused; the eye does not minutely discover what is separated from it. At the length of a field or street, we descry human figures, but the features of their faces, and the folds of their garments, are imperceptible to us; and so the innumerable leaves that grow on distant plantations, appear to the sight but one mass.

*Directions for mixing and making Colours.*

**YELLOW.** **G**UMBUGE is a most beautiful yellow; by putting water to a lump of this, it soon dissolves, and is made paler or deeper to your liking: but no gum-water is to be used, it being a gum itself; nor should this yellow be used on prints designed to be varnished, for the varnish takes this colour quite off. This is sold cheap, and may be had at any druggist's.

*Gall-stone* is a fine transparent colour of an orange tinge, very fit to glaze with, or to shade the yellow with.

*Dutch-pink* is another yellow, and should be used when prints are designed for varnishing.

**GREEN.** *Distilled-verdigrise* is a bright shining green, to be used very sparingly, and with judgment : but the addition of a little gumbuge makes it look far pleasanter. This is bought in phials, ready prepared : the colourmen tell you, it is very troublesome to make : and no doubt, sell it dear.—But more of this in its proper place.

*Sap Green* is a lump dissolved in water : and is used with most advantage when plenty of water is put to it : otherwise it is very dark and unpleasant.

*French-Berries*, are to be dissolved in water, and afford but an odd kind of green, unless mixed with some other article. Gum water is not to be used with these berries : or with the Sap-green above-mentioned.

*Indigo and Gumbuge*, mixed together, make a very agreeable green : and you may suit it to your liking, as you put more or less of the gumbuge : but judgment and fancy must direct what tinge is most agreeable in this and all other colours.

**BLUE.** *Ultramarine*, is the finest of all blues ; it is sold extravagantly dear ; but indeed a very little goes a great way, when it can be procured of the right sort : which is indeed rarely to be met with, notwithstanding the high price it bears.

*Smalt*, if very fine, is a good blue : of itself it is but a heavy colour, difficult to lay smooth and be transparent : on which account care and judgment are required in using it.

*Indigo*, a deep heavy blue, proper for a dark shade, &c.

*Verditer*, a fine sky-blue ; but it is to be used sparingly, and with discretion.

*Prussian Blue*, is a fine blue, if laid on very thin, and proper to shade other blues with : but it is best when used in oil-colours.

**CRIMSON and RED.** *Carmin*, is the finest of all reds ; it affords a bright and beautiful colour, when good, and flows easily in the pencil ; and with the same colour, or lake, you may make the shades as strong as you please.

*Lake*, is likewise a fine transparent colour, and is, when of a good kind, preferable to some carmine.

*Red-Lead*, a powder, if fine, affords a good colour; but it being of a heavy nature, care must be taken that it be not laid on too thick, which would prevent its being transparent: it is likewise apt to turn blackish, unless it be well cleansed and refined. See washed red-lead.

*Vermillion*, we may say the same of as of the red-lead.

**ORANGE.** Lay first a tint of gumbuge, and over that some red lead, or carmine, or lake, either will do.

**PURPLE.** *Carmine and Ultramarine*, mixed together, make the finest of all purples.

The above colours, by blending two together, may be altered to quite another tint: though in doing this, no certain rule can be laid down, but fancy, with judgment, must direct. In using the colours, great care should be taken to lay the first colour on very thin, or pale, by which means the shade will appear stronger, and the whole more beautiful. In most cases, if the white paper was left in the lights of the object, whether flower or figure, and only the shades to be coloured, would be best: or, should the white paper be thought to appear in too glaring a light, then (afterwards) a very thin tint may be laid on. And this caution I would advise to be universally observed, to lay on all colours very thin at first, it being easy to make the light parts deeper; but the damage is not easily repaired, when the colour is laid on too thick at first.

*Some necessary Remarks on Colours, &c.]* As the the preparation of distilled verdigrise is pretended to be both tedious and troublesome, I will here put it in the practitioner's power to make his own; which, if my directions are followed, I will answer for its being full as good, if not better, than what is sold at the colour-shops.

Distilled verdigrise, used in colouring prints, and in the present mode of painting, is a liquid, and which I have before mentioned, as such, under the article of



greens. You are to procure an ounce of distilled verdigrise, in the lump, which will cost about eight pence ; this you are to bruise small, and then put it into twelve ounces of the best white wine vinegar, which must not only be strong, but very fine ; shake it well in the bottle, at first putting in, and let it stand in the sun, or some place that is warm, for a day or two, often shaking it, and it will then be fit for use. This is the very extraordinary trouble of making the liquid distilled verdigrise, and for which the venders are so well paid. They, indeed, add about a spoonful of brandy to the above quantity ; which can only be to disguise it, as it cannot be the least service : in common writing ink, brandy is said to prevent its turning mouldy, &c. but I have used the article above mentioned both with and without the brandy, and kept it many months, and could not perceive the difference ; but that is the preparation of the shops. You are, however, to remark, that this liquid is best kept on the fine powder that you will perceive at the bottom of the bottle, being no way troublesome, and will soon precipitate, and be fine for use : it being best to pour off a very small quantity into a bottle or gallipot, when you are using it. A little of this goes a great way : it flows well in the pencil, and may be used with a pen, even as well as common writing ink, if required. It is a very shining green, but may be made pleasant and agreeable, by mixing more or less gumbage with it, according as your fancy directs, or circumstances require.

I should have mentioned saffron among the yellows, as being the highest of all, and appearing fine and delightful ; but as this colour is very apt to fly, I must own, I make very little use of it ; and not at all, without being well loaded with gum ; nor will it bear varnish by any means.

As a good blue is the most difficult to procure, especially at an easy price, I will here insert a very valuable one ; I don't give it as an invention of my own, but acknowledge we are indebted to the ingenious Mrs. Ma-

riana for it, as I have before hinted ; and it is thus prepared, according to her directions.

“ Take, says she, half an ounce of the finest Litmus : it must be powdered very fine ; Prussian-blue half a drachm, powdered very fine likewise : eight ounces of the clearest small beer wort, while it is running : the above articles are to be thrown into the wort while warm ; they are then to be put into a new earthen vessel, that is extremely well glazed, and remarkably sweet and clean : to be set over a moderate fire till it boils, then to be taken off, stand till cold, and it is to be kept for use. N. B. If this is made in summer time, when corn is near ripe, throw in, when cold, half a scruple of those fine blue flowers that are often to be found among wheat, as it grows in the fields : it will be a most heavenly blue ; but great care must be taken that it touches not the least acid, for that spoils all.”

Mrs. Mariana gives great caution, to beware that acid interferes not in the above curious colour : but the greatest difficulty seems to me to know how to prevent it.—For, supposing that the wort in itself had no acid property when first made use of ; yet in a hot season it would no doubt be not only acid, but even very sour, a few days after making, and thereby become useless, if so very trifling an acid, as she observes, would deprive it of its beauty ; and which I myself have often experienced, and found to be true. In fact, the colour is truly beautiful, and I have generally succeeded in the preparation when I observed the following cautions, viz. First, that the earthen vessel (for no other will answer the end) be well glazed and clean ; I then throw in a large lump of fine soft chalk, add as much water thereto as will fill the vessel, and then set it on a slow fire 'till it is very hot ; I afterwards cover it up and let it remain three or four hours, and then clean it very well. Secondly, I procure my new wort after the following manner : having obtained about four ounces of the finest pale malt, I put this into a tea-pot, without being either ground or even bruised ; and put about twelve

ounces (three quarters of a pint) of fine soft river water, boiling hot, thereto; I let this stand near the fire, so as to keep it warm, an hour, afterwards I pour it off, and it will be fit for the use according to the directions of Mrs. Mariana. It is to be observed, that the water, of which the wort is made, ought to be of the most pure kind, very soft, and extremely fine; for much depends on it. And 'tis not to be wondered at, that many have miscarried in making this curious article, since they all procure the wort from any one that happens to be brewing. I must own I have made an extreme good blue with only the Litmus (it is best known by the name of Lacmus, and sells for about four-pence the ounce) being powdered and gently boiled in the fine wort above-mentioned; it will soon jelly and grow hard, and will keep in that manner for a year, or more; it is made liquid immediately, by only dipping the pencil in fair soft water, and touching it as you do Indian-ink.

I am not in this place going to treat of the common black writing ink; perhaps it might well answer the end of those who make and deal in it, to be better acquainted with the easy preparation of wort and litmus boiled together. This, without much care, trouble or expence, will make a good blue, that will flow in the pen better than the ink commonly made use of; and as to its growing soon hard (and more so, if long boiled, and left to cool in very small quantities) it is a property that makes it far more valuable, especially for those who travel; because it will keep, in a dry place, a long time, and soon liquefy again. In one word, it will make the best black writing ink in the universe, with the addition of some bruised galls, &c. but in this case no gum is to be used.—It may be remembered, that all good blacks should be raised from blues.

Mariana's fine blue has got discredit by some, from a circumstance little thought of. I remember lady Ferrers, after saying a great deal in its favour, complained that it would not hold its colour. Know then, that a great part of the fine writing paper has what the mak-

ers call an alum size laid on it, which intirely spoils this fine tender blue; and so it does a sort of mixture—too often sold for ultramarine. But paper, sized after this manner, is soon known, by only putting the tongue thereto.

I make a blue that I find of good service after the following manner: having procured some of the finest Prussian blue, I powder it, and grind it well with a strong gum water, made of the clearest sort of gum-arabic. After it is sufficiently fine, I add some flake white thereto, which I also grind well in; and by adding more or less of the white, I make it lighter or darker, to my fancy. But, indeed, I generally keep three or four degrees, which I make up into small squares, and use it in the same manner I do the Indian-ink.

There is a sort of brown, much used by those who colour prints, which is quite transparent, and to be had in all places: procure a small quantity of the most mild pale tobacco; put a very little of this to a spoonful of common water in a cup or gallipot, and in a few minutes you will have a good brown colour, that suits on many occasions; and it may be made quite dark, by adding more of the leaf, or by putting hot water to it. Gum-water is not to be used with this article, unless it be very weak. I know an objection will be made against the tobacco on account of its smell; but it is a mistake, for the smell goes off immediately: indeed the colourmen don't approve of it; and I well know the reason of their dislike; it would be the best of browns, if they could contrive to disguise it, and sell it a great price, as they do many of their other articles, which in themselves are very trifling.—Pray how does their Gallstone, &c. smell?

Rose pink is no bad colour, if of a good sort: this I manage as I do the Prussian-blue, and keep it dry in a cake; two sorts will be sufficient, one lighter than the other; which is made by the addition of the flake-white, as directed in the blue.

Black should never be mixed with any colour, because it makes it look disagreeable and dirty. Indeed I seldom use any other black than Indian-ink, nor other white than flake-white, though I know white-lead is often used ; but the other is best.

Washed red-lead is a fine colour, and comes reasonable ; nor is the trouble much to prepare it. You are to procure half a pound of the finest red-lead, which must be finely powdered : put this into a mug, and stir it about well in near a quart of clear soft water ; pour the water off into another mug, stir it about, and again pour it off ; stir it, and pour it off again, and do in this manner six or seven times, always observing to pour as long as it will run, and leave the powder that precipitates to the bottom of each mug (which will grow less and less) to dry ; and though, in the whole, you will not have above half a drachm ; yet, if the red-lead was good, you are sure of a fine colour left at the bottom of each mug, which will soon dry, and may be ground with gum-water, and kept in shells for use.

Vermillion may sometimes be improved in the same manner ; but as there are different preparations of it, and some of them will not answer this operation, I would by no means advise it.

Logwood boiled in clear stale beer, and a little fine Brazil-wood added thereto, makes a tolerable purple, which remains liquid.

But a good purple, intended for keeping, is to be made thus : new wort one pint, litmus one ounce, fine Brazil, bruised, one ounce, let these boil over a slow fire, about half an hour, in a clean new mug, well glazed. When cold, strain it off, and keep it for use. If this is left in small quantities, it will be apt to jelly and grow dry : but, if designed to be kept liquid, add a little spirits of wine thereto, and keep it in a large bottle.

A delightful red, not inferior to carmine, is made thus ; spirits of wine eight ounces, of the finest lake one drachm, ripe barberries half an ounce, dragon's-blood, of the reddest sort, one drachm, fine Brazil-wood a quarter of an ounce ; this is to remain seven or



eight days in the sun, or moderate heat, in a phial well corked; you are to shake the bottle often; and after you see the colour very high and delightful, which it will be in little more than a week, let it settle, and pour it off for use. It should be in a clear flint glass bottle, that you may the better observe the colour. After standing some time, and you find it very fine, you may put a few drops into a shell, or on a Dutch-tile, smooth glass, &c. which will soon dry: you may then rub into it a little clear gum water, which gives it a better body, or it may be used liquid in many cases.

The colours I have already mentioned, are sufficient, by being blended together, to form a sufficient variety for most purposes, and for doing which I can lay down no certain rule, but must leave it to the fancy and judgment of the practitioner.

*To make a Varnish for Silver.*] Melt, in a well glazed pipkin, some fine turpentine, and put in three ounces of white amber, finely powdered (more or less, according to the quantity your work will require) put it in by little and little, keeping it continually stirring, adding by degrees, some spirit of turpentine, till all the amber is dissolved: then add to it an ounce of Sarcocolla well beaten, and an ounce of gum elemi well levigated, adding now and then a little spirit of turpentine, till all is dissolved: do this over a gentle fire, and keep it constantly stirring. This varnish is to be used warm, and hardened by degrees in an oven, whereby it will look like polished silver.

*Manner of Engraving on Copper, &c.*] This is performed with a graver on a plate of copper, which being well polished, is covered over thinly with virgin-wax, and then smoothed while warm, with a feather, so that the wax be of an equal thickness on the plate: on this the draught or design, done in blacklead, red chalk, or ungummed ink, is laid with the face of the drawing on the wax: then they rub the back side, which will cause the whole design of the drawing to appear on the wax. The design, thus transferred, is traced through the copper, with a point, or needle: then beating the plate,

and taking off the wax, the strokes remain to be followed, heightened, &c. according to the tenor of the design, with the graver, which must be very sharp, and well pointed. In the conduct of the graver consists almost all the art, which depends not so much upon rules, as upon practice, the habitude, disposition, and genius of the artist, the principles of engraving being the same with those of painting; for if the engraver be not a perfect master of design, he can never hope to arrive at any degree of perfection in this art. In conducting the strokes or cuts of the graver, he must observe the action of the fingers, and of all their parts, with their out-lines; and remark how they advance towards, or fall back from his sight, and then conduct his graver, according to the risings or cavities of the muscles or folds, widening the strokes in the light, and contracting them in the shades: as also at the extremity of the out-lines, to which he ought to conduct the cuts of the graver, that the figures or objects represented, may not appear as if they yawn; and lightening his hand, that the out-lines may be perfectly found, without appearing cut or slit: and altho' his strokes necessarily break off where a muscle begins, yet they ought always to have a certain connection with each other, so that the first stroke should often serve to make the second, because this will show the freedom of the graver. If hair be the subject, let the engraver begin his work by making the out lines of the principal locks, and sketch them out in a careless manner, which may be finished at leisure with finer and thinner strokes to the very extremity. The engraver must avoid making very acute angles, especially in representing flesh, when he crosses the first strokes with the second, because it will form a very disagreeable piece of tabby like lattice work, except in the representation of some clouds, in tempests, the waves of the sea, and in representations of skins of hairy animals, and leaves of trees. So that the medium between square and acute seems to be the best and most agreeable to the eye. He that would represent sculpture, must remember that, as statues, &c. are most

commonly made of white marble, or stone, whose colour does not produce such dark shades as other matters do, have no black to their eyes, nor hair of the head, and beard flying in the air. If the engraver would preserve one quality and harmony in his works, he should always sketch out the principal objects of his piece before any part of them are finished. The instruments necessary for this sort of engraving are, besides a graver, a cushion, or sand bag, made of leather, to lay the plate on, in order to give it the necessary turns and motions; a burnisher made of iron or steel, round at one end, and usually flattish at the other, to rub out slips and failures, soften the strokes, &c. a scraper, to pare off the surface, on occasion; and a rubber of a black hat, or cloth roiled up, to fill up the strokes, that they may appear the more visible.

*Method of Etching on Copper, &c.*] Etching is a method of engraving on copper, in which the lines, or strokes, instead of being cut with a tool or graver, are eaten in with aquafortis: and this is done with more ease and expedition than engraving; it requires fewer instruments, and represents most kind of subjects better and more agreeable to nature, as landscapes, ruins, grounds, and all small faint, loose, remote objects, buildings, &c. The method of etching is as follows: choose the copper plate as directed for grav- ing, and furnish yourself with a piece of ground, tied up in a bit of thin silk, kept very clean, to be laid upon the plate when both have been warmed; proper needles to hatch with on the ground; a pencil or brush to wipe away the bits of ground which rise after hatching; a polisher; two or three gravers; a pair of compasses, to measure distances and draw circles; a ruler, to hatch straight lines; green wax, to make the wall round the edges of the plate, to contain the aqua- fortis; an oil stone; a bottle of aquafortis; some red- lead, to colour the back side of the copy; a stift, and a hand-vice, to hold the plate over the candle. To make the ground, take three ounces of asphaltum, two ounces of clean rosin, half an ounce of burgundy-

pitch, three ounces of black wax, and three ounces of virgin's wax : let all these be melted in a clean earthen pipkin over a slow fire, stirring it all the time with a small stick : if it burn to the bottom, it is spoiled. After the ingredients are well melted, and it boils up, put it into a pan of fair water : and before it be quite cold, take it out, and roll it into small lumps to be kept from dust : this ground is what others call the varnish. The next thing is to clean the plate to receive the ground : take a piece of lissing, roll it up as big as an egg, tie it very tight, so as to make it a rubber, and having dropt a small quantity of sweet oil, and added a little powder of rotten stone on the plate, rub it with this ball, till it will almost show your face. Then wipe it all off with a clean rag, and after that, make it quite dry with another clean rag, and a little fine whiting. The next thing is to lay on the varnish : to do which aright you must take a hand-vice, and fix it at the middle of one part of the plate, with a piece of paper between the teeth of the hand vice and the plate, to prevent the marks of the teeth : then laying the plate on a chafing dish, with a small charcoal fire in it, till the plate be so hot, that by spitting on the backside, the wet will fly off ; rub the plate with the ground tied up in silk, till it be covered all over ; and after that daub the plate, with a piece of cotton wrapped up in silk till the ground be quite smooth, keeping the plate a little warm all the time. The varnish being thus smoothed upon the plate, it must be blacked in the following manner : take a thick tallow candle that burns clear, with a short snuff, and having driven two nails into the wall, to let it rest upon, place the plate against the wall with the varnish side downward, and take care not to touch the ground with your fingers : then taking the candle, apply the flame to the varnish as close as possible, without touching the varnish with the snuff of the candle, and guide the flame all over it, till it becomes perfectly black. After this is done, and the plate dry, the design is traced with a needle through the varnish, and a rim or border of wax is raised round

the circumference of the plate ; and then the artist has a composition of common varnish and lamp-black, made very thin, wherewith he covers the parts that are not to be bitten, by means of a hair pencil. And he is every now and then covering or uncovering this or that part of the design, as occasion may require ; the conduct of the aquafortis being the principal concern, on which the effect of the print very much depends. The operator must be attentive to the ground, that it does not fail in any part, and where it does, to stop up the place with the above composition. The plate is defended from the aquafortis every where, but in the lines or hatches cut through it with the needle, through which the water eats into the copper to the depth required ; remembering to keep it stirring with a feather all the while, which done, it is to be poured off again. Single aquafortis is most commonly used ; and if it be too strong, mix it with vinegar, otherwise it will make the work very hard, and sometimes break up the ground : the aquafortis having done its parts, the ground is taken off, and the plate washed and dried ; after which nothing remains for the artist but to examine the work with his graver, to touch it up, and heighten it where the aquafortis has missed. And lastly, it is to be remembered, that a fresh dip of aquafortis is never given, without first washing out the plate in fair water, and drying it at the fire.

*Different Ways of making Carmine.*] It is extracted from cochineal, by means of water, wherein chouan and antour have been infused : some add rocou, but this gives too much of the oval cast. Others make carmine with brazil-wood, fernambouc and leaf gold, beat in a mortar, and steeped in white-wine vinegar : the scum arising from this mixture, upon boiling, when dried, makes carmine : but this kind is vastly inferior to the former. There is another carmine, made of brazil-wood and fernambouc. But a sort, that is too often met with, is prepared from shreds of superfine scarlet cloth, infused in spirits of wine.

*The preparation of Ultramarine.*] This is prepared



from lapis lazuli, by calcination : but the German lapis lazuli does not answer well in this process, and discovers itself by calcining easier than the African or Asiatic, and turning greenish. The oriental kind calcines to a finer blue than it naturally has, and retains the colour for ever. After calcining the stone in a clear fire of charcoal, they grind it to an impalpable powder on a porphyry, and then mixing it up in a paste, composed of pitch, wax, and oil, they work it about with the hands: and finally, kneading this in a vessel of clear water, as the powder separates from the viscid matter it sinks to the bottom: when all that is perfectly fine is this is worked out, they let the water be drained off, and dry the powder for use. What remains embodied in the paste is afterwards separated, and makes a worse kind than the former. Ultramarine must be chosen of a high colour, and well ground, which may be known by putting it between the teeth, and if it feel gritty, it is a sign it has not been well ground. To know whether it be pure and unmixed, put a little of it into a crucible and so heat it red hot; and if the powder has not changed its colour after this trial, it is certainly pure: on the contrary, if there be any change, or any black specks in it, then it has been adulterated. There is also a spurious sort, commonly called Dutch ultramarine, which is only fine smalt well ground and pulverised: and this sort is too often sold at a most extravagant price.

*To soften Ivory and other Bones.*] Lay them for twelve hours in aquafortis, and then three days in the juice of beets, and they may be worked into any form. To harden them again, lay them in strong vinegar. Dioscorides says, that by boiling ivory for the space of six hours with the root of mandragoras, it will become so soft, that it may be managed as one pleases.

*To whiten Ivory.*] Lay it in quick lime, and pour a little water over it, but not too much that the heat may not be too great, lest it scale and become brittle.

*Staining and marbling of Ivory.*] 1. Of a fine coral red: make a lye of wood-ashes, of which take tw

quarts, pour it into a pan upon one pound of brazil; to this add one pound of alum; boil it for half an hour: then take it off, and put in the ivory or bone, and the longer either of these continue in the liquor, the redder they will be. 2. Of a fine green: take two parts of verdigrise, and one part of sal ammoniac: grind them well together, pour strong white wine vinegar on them, and put your ivory into this mixture, let it be covered till the colour has penetrated, and as deep as you would have it. If you would have it spotted with white, sprinkle it with wax; or if you would have it marbled, cover it with wax, and scrape it off in veins, having all the lines uncovered which you desire to have stained. 3. Of black: take litharge and quick-lime, of each an equal quantity; put them in rain water over the fire till it begins to boil, and in this put the bone or ivory, stirring them well about with a stick; and afterwards when you see the ivory receive the colour, take the pan from the fire, stirring the ivory all the while till the liquor is cold. 4. Marbling upon ivory is performed thus: melt bees-wax and tallow together, and lay it over the ivory, and with an ivory bodkin open the strokes that are to imitate marbling: pour the solution of some metal on them, and when it has stood a short time, pour it off: when it is dry, cover the strokes again with the wax, and open some other veins with your bodkin for another metallic solution; and this repeat to the number of colours you design to give it. The solution of gold gives it a purple; of copper, a green; of silver, a bad black; of iron, a yellow and brown. By this method you may also imitate tortoise-shell, and several other substances on ivory.

*The true Method of making Sealing-wax, &c.]* Take one pound of bees-wax, three ounces of fine turpentine, olive oil, and rosin (finely powdered) of each one ounce: when they are well melted, and dross taken off, put in an ounce and a half of vermilion, or red lead, finely ground, and stir them together till they are well incorporated, when this mixture grows a little cool, roll it into sticks, or in any other form you would have it.

If you would have it black, instead of vermillion, or red-lead, put into it lamp-black—The soft, red, and green wax, used in large seals to some of our law writings, are thus made : melt bees wax over a gentle heat ; with such a proportion of Venice turpentine as, when cold, will give it the due consistence : this is determined by repeated trials ; first putting in but little turpentine, and afterwards more and more, till by dropping a piece upon a marble to cool, it is found of the true consistence. They then colour it with vermillion, or red-lead, or with verditer, or whatever colour they please, the mixture in this state, receiving any.

*To imitate Fruit in Wax.*] Take the fruit, and bury it half way in clay ; oil its edges, and that part of the fruit which is uncovered : then nimbly throw on it tempered alabaster, or plaister of Paris, to a considerable thickness. When this is grown dry and hard, it makes the half mould ; the second half of which may be obtained in the same manner. The two parts of the mould being joined together, a little bees wax melted and brought to a due heat, being poured through a hole made in a convenient part of the mould, and presently shook therein, will represent the original fruit.

*How to represent the Face, &c. in Wax*] The representation of the face, &c. of persons living, or dead, is done by applying plaister of Paris in a kind of paste, and thus forming a mould containing the exact representation of the features. Into this mould melted wax is poured, and thus a kind of masks are formed ; which being painted and set with glass eyes, and the figures dressed in their proper habits, they bear such a resemblance, that it is difficult to distinguish between the copy and the original.

*Of Varnishes in general.*] There are several kinds of varnishes in use ; as the siccativ or drying varnish, made of oil of aspin, turpentine and sandarach melted together. White varnish, called also Venetian varnish, made of oil of turpentine, fine turpentine and mastic. Spirit of wine varnish, made of sandarach, white amber, gum elemi and mastic ; serving to gild leather, picture

frances, &c. withal. Also the gilt varnish, china varnish, common varnish, &c.

*To make white Varnish.*] Take gum sandarach, of the clearest and whitest sort, eight ounces; gum mastic, of the clearest sort, half an ounce; of sarcocolla, the whitest, three quarters of an ounce; Venice turpentine, an ounce and a half; benzoin, the clearest, one quarter of an ounce; gum animæ, three quarters of an ounce; let all these be dissolved, and mixed in the manner following: Put the sarcocolla and rosin into a little more spirits than will cover them to dissolve: then add the benzoin, gum animæ, and Venice turpentine, into either a glass or glazed earthen vessel, and pour on as much spirits as will cover them an inch: then put the gum mastic into a glass or glazed vessel, and pour strong spirits upon it, covering it also about an inch thick, to dissolve it rightly: then put your gum elemi in a distinct vessel as before, and cover it with spirits to dissolve. For this purpose, you need only break the rosin a little, and powder the gum animæ, sarcocolla, and benzoin. Let all stand three or four days to dissolve, shaking the glasses, &c. two or three times a day, and afterwards put them all together into a glazed vessel, stirring them well, and drain the liquor and gums gently, beginning with the gums, through a linen cloth. Then put it into a bottle, and let it stand a week before you use it, and pour off as much of the clear only, as you think sufficient for present use.

*The white Amber Varnish, according to Mr. Boyle.*] Take white rosin four drachms, melt it over the fire in a clean glazed pipkin; then put into it two ounces of the whitest amber you can get, finely powdered. This is to be put in by a little and little, gradually, keeping it stirring all the while with a small stick, over a gentle fire, till it dissolves, pouring in now and then a little oil of turpentine, as you find it growing stiff; and continue so to do till all your amber is melted. But great care must be taken not to set the house on fire, for the very vapours of the oil of turpentine will take fire by heat only; but if it should happen so to do, immediately

put a flat board or wet blanket over the fiery pot, and by keeping the air from it, you will put it out, or suffocate it. Therefore it will be best to melt the rosin, in a glass of cylindric figure, in a bed of hot sand, after the glass has been well annealed, or warm'd by degrees in the sand, under which you must keep a gentle fire. When the varnish has been thus made, pour it into a coarse linen bag, and press it between two hot boards of oak or flat plates of iron; after which it may be used with any colours in painting, and also for varnishing them over when painted. But for covering gold, you must use the following varnish; mean time, it is to be observed, that when you have varnished with white varnish, you may put the things varnished into a declining oven, which will harden the varnish.

*A hard Varnish, that will bear the Muffle.*] Take of colophony, an ounce; set it over the fire in a well glazed earthen vessel, till it is melted; then by little and little, strew in two ounces of powder of amber, keeping it stirring all the while with a stick; and when you perceive it begin to harden or resist the stick, then put in a little turpentine oil, which will thin and soften it immediately: then put in two ounces of gum copal, finely powdered, sprinkling it in as you did the amber, now and then pouring in a little oil of turpentine; and when it is done, strain it as before directed. This is proper to varnish over gold; and the things done with it must be set into a declining oven, three or four days successively, and then it will resist even the fire itself.

*To make a Varnish for Gold, or Metals made in imitation of Gold.*] Take colophony, and, having melted it, put in two ounces of amber finely powdered, and some spirit of turpentine, and, as the amber thickens, keep it well stirring; then put in an ounce of gum elemi, well pulverised, and more spirit of turpentine; constantly stirring the liquor till all is well mixed and incorporated: but take care, however, to use as little turpentine as you can, because, the thicker the varnish is made, the harder it will be. Let this be done over a sand heat, in an open glass; then strain



it, as is directed for the preceding varnish. This varnish is to be used alone, first warming the vessels made of paper paste; and lay it on with a painting brush before the fire, but not near, lest the fire raise it into blisters. After this has been done, harden it three several times in an oven; first with a slack heat, the next with a warmer, and the third with a very hot one; and the vessels will look like polished gold. And as for such vessels, &c. as shall be made with saw dust and gums, the varnish may be made of the same ingredients as above-mentioned, except the gum elemi; and this will dry in the sun, or in a gentle warmth.

*Laying on of Varnishes.*] 1. If you varnish wood, let your wood be very smooth, close grained, free from grease, and rubbed with rushes. 2. Lay on your colours as smooth as possible; and, if the varnish has any blisters in it, take them off by a polish of rushes. 3. While you are varnishing, keep your work warm but not too hot. 4. In laying on your varnish, begin in the middle, and stroke the brush to the outside; then to another extreme part, and so on till all be covered; for if you begin at the edges, the brush will leave the blots there, and make the work unequal. 5. In fine works use the finest tripoli in polishing: do not polish it at one time only; but, after the first time, let it dry for two or three days, and polish it again for the last time. 6. In the first polishing you must use a good deal of tripoli, but in the next a very little will serve; when you have done, wash off your tripoli with a sponge and water; dry the varnish with a dry linen rag; and clear the work, if a white ground, with oil and whiting; or if black, with oil and lamp black.

*Painting in Oil.*] The whole secret of painting in oil consists in grinding the colours with nut-oil, or linseed-oil; but the manner of working is very different from that in fresco, or in water, by reason the oil does not dry near so fast, which gives the painter an opportunity of touching and re-touching all the parts of his figures as often as he pleases; which in the other methods of painting is a thing impracticable. The figures done

in oil, are also capable of more force and boldness ; inso-much, that the black becomes blacker, when ground with oil, than with water ; besides, all the colours mixing better together, makes the colouring the sweeter, more delicate and agreeable, and gives an union and tenderness to the whole, inimitable in any of the other manners. Painting in oil is performed on canvas, on walls, wood, stone, and all other sorts of medals.

*Painting on Cloth or Canvas is done as follows.*] The canvas being stretched on a frame, give it a layer of size, or paste-water, and then go over it with a pumice-stone, to smooth off the knots. By means of the size, the little threads and hairs are all laid close on the cloth, and the little holes filled up, so that no colour can pass through. When the cloth is dry, lay on okre in oil, which may be mixed with white-lead to make it dry the sooner. When dry, go over it again with the pumice-stone, to make it smooth. After this a second couch is sometimes applied, composed of white-lead and a little charcoal-black, to render the ground of an ash colour. Others prime the canvas in the following manner ; they first smooth the canvas with a pumice-stone, size it over with good size, and a little honey, and let it stand to dry ; after which they lay it over with whiting and size, mixed with a little honey : the use of the honey is to prevent it from cracking, peeling, and breaking out ; on this they first draw the picture with a coal, and then lay on the colours.

*Painting on Walls.*] When the wall is dry, they give it two or three washes with boiling oil, till the plaister remains quite greasy, and will imbibe no more ; upon this they lay drying colours, such as white chalk, red okre, or other chalks beaten pretty stiff. When this couch or layer is well dried, the subject, or design, is sketched out, and afterwards painted over, mixing a little varnish with their colours, to save the varnishing afterwards. In order the better to fortify the walls against moisture, some cover it with a plaister of lime, marble dust, or cement made of beaten tiles soaked in linseed-oil ; and at last prepare a composition of Greek

pitch, mastic, and thick varnish boiled together, which they apply hot over the former plaister; and when dry, lay on the colours as before. Others, in fine, make their plaister with lime-mortar, tile cement, and sand; and this being dry, they apply another of lime, cement and iron-scoria; which being well beaten, and incorporated with linseed-oil, and whites of eggs, make an excellent plaister. When this is dry, the colours are laid on as before.

*In Painting on Wood.*] They usually give their ground a couch or layer of white tempered with size, and then proceed as in painting on walls.

*In Painting on Stone or Metals.*] It is not necessary to lay them over with size, but only to add a slight couch of colours before the design is drawn on it: nor even is this done on stones, where you would have the ground appear, as in certain marbles and agates of extraordinary colours.

*All the Colours used in Fresco.*] Are good in oil, except white of lime and marble dust. Those chiefly used are white-lead, or ceruse, yellow and white masticot, orpiment, vermilion, lacca, blue and green ashes, verdigrise, indigo, smalt, black-lead, ivory-black, lamp-black, &c. As to oils, the best of those are linseed, walnuts, spike, and turpentine. The drying oils are nut oil, boiled with litharge and sandarach, or otherwise with spirit of wine, mastic and gum lacca. In the preparation of oil-colours, care must be taken that they be ground fine: that in putting them on a pallet, those which will not dry of themselves be mixed with drying oil, or other ingredients of a drying quality: and that the tinged colours be mixed in as small quantities as possible. As to the situation of the colours, the purest and strongest must be placed in the front of the piece, and the colouring varied according to the subject, time and place. If the subject be grave, melancholy or terrible, the general tint of the colouring must incline to brown and black, or red and gloomy: but it must be gay and pleasant in subjects of joy and triumph.

*Colour, in Dying, &c.*] There are, in the art of

dying, five colours, called simple, primary, or mother colours, from the mixture of which all other colours are formed: these are blue, yellow, brown, red and black. Of these colours, variously mixed and combined, they form the following colours, pansy, blue and scarlet are formed: amaranth, violet, and pansy: from the same mixture of blues, crimson and red, are formed the columbine or dove colour, purple crimson, amaranth, pansy, and crimson violet. Here it is to be observed that they give the name crimson to all colours made with cochineal.

*Of blue and red madder is died purple, pepper colour, tan colour, and dry rose colour.*

The same blue with red half in grain, makes amaranth, tan colour, and dry rose colour.

*Blue and half red crimson, compose amaranth, tan colour, dry rose, a brown pansy, and sun brown.*

*Blue and yellow, mixed together, compose a yellow green, spring green, grails green, laurel green, brown green, dark green, as well as sea green, parrot green, cabbage green, &c. These three last colours are to be less boiled than the rest. It is to be noted, that as to green, there is no ingredient or drug in nature that will dye it: but the stuffs are dyed twice, first in blue, then in yellow.*

*Blue and brown.] These two colours are never mixed alone, but with the addition of red, either of madder or cochineal, they form several colours.*

*Red and yellow.] All the shades composed of these two colours, as gold, yellow, aurora, marygold, orange, nacarat, granat-flower, flame colour, &c. are made with yellow and red of madder, scarlet being less proper as well as too dear.*

*Red and brown.] Of these two colours are formed cinnamon colour, chesnut, musk, bear's hair, and even purple, if the red be of madder.*

*Yellow and brown.] The colours formed from these two, are all the shades of feuilemorte, and hair colours. But this may be taken notice of, that though it be said that there are no colours or shades made from such and*

such mixtures, it is not meant that none can be made, but that they are more easily formed from a mixture of other colours.

*[Dying in general.]* The art of dying consists in giving a lasting colour to silks, cloths, and other substances, whereby the beauty is much improved, and value enhanced: and this art chiefly depends on three things, viz. 1. Disposing the surface of the stuffs to receive and retain the colours, which is performed by washing them in different lyes, digesting, beating them, &c. in which human urine putrified, a sharp salt of ashes, divers soaps, and galls of animals, are of principal use; by means whereof the viscous gluten of the silk-worms naturally adhering to their threads, is washed and cleansed from them, and thus they become fitted gradually to imbibe the colours. By these also the greasy foulness adhering to wool and flax is scoured off. 2. So to grind the colours, as that they may enter the body only prepared, and preserve their brightness undiminished. 3. The third consists in having beautiful colours.

*[The Materials used in the Art of Dying.]* Are iron and steel, or what is produced from them, in all true blacks, called Spanish blacks, though not in Flanders blacks, viz. they use copperas, steel filings, and slippe; they also use pewter for bowe-dye scarlet, viz. they dissolve bars of pewter in aquafortis; litharge is also used by some, though acknowledged by few to add weight to dyed silk. Antimony is much used to the same purpose. Arsenick is used in crimson upon pretence of giving lustre, although those who pretend not to be wanting in giving lustre, to their silks, disown its use. Verdigrise is also used by linen dyers in their yellow and greenish colours; though, of itself, it strikes no deeper colour than that of a pale straw. Of mineral salts used in dying, the chief is alum; the true use whereof seems to be in regard to the fixation of colours. The next mineral salt is salt-petre, not used by antient dyers and but by few of the modern: nor is it yet used but to brighten colours, by back boiling of them, for



which argol is more commonly used : lime is much used in working blue vats.

Of the animal family are used cochineal, urine of labouring men kept till it be stale and stinking, honey, yolks of eggs, and ox-gall ; the use of the urine is to scour, and help the fermenting and heating of wool ; and is used also in blue vats instead of lime : it dischargeth the yellow, and therefore is used to spend well withall.

Dyers use two sorts of water, viz. river and well water ; the last, which is harsh, they use in reds and other colours wanting restraining, and in dying materials of the flacker contextures, as in callico, fustian, and the several species of cotton works ; but it is not good for blues, and makes yellows and greens look rusty.

River water is more fat and oily, and is therefore used in most cases, and must be had in great quantities for washing and rinsing their cloths after dying. Water is called by dyers white liquor ; but a mixture of one part bran, and five of the river water boiled an hour and put into leaden cisterns to settle, is what they call liquors absolutely.

Gums have been used by dyers about silk, viz. gum arabic, tragacanth, mastic, dragon's blood. These tend little to the tincture, any more than gum in writing ink, which only gives it a consistence : so gum may give the silk a glossiness ; and lastly, to increase the weight.

The three peculiar ingredients for black are copperas, filings of steel, and slippe ; the restraining binding materials are alder-bark, pomegranate peels, walnut rinds and roots, oaken sapling bark, and saw-dust of the same, crab tree bark, galls, and sumac.

The salts are alum, salt-petre, sal ammoniac, pot ashes, and stone lime ; among which urine may be enumerated as a liquid salt.

The liquors are well and river water, urine, aquavita, vinegar, lemon juice, aquafortis, honey, and mallowes.

Ingredients of another class are bran, wheaten flour,

yolks of eggs, leaven, cummin seed, fenugreek seed, agaric and fenna.

The smectics, or abstersives, are fuller's earth, soap, linseed oil, and ox-gall.

The metals and minerals are pewter, verdigrise, antimony, litharge, and arsenic.

The colourings are of three sorts, viz. blue, yellow, and red; of which logwood, old fustic, indigo and madder, are the chief.

*General Observations upon Dying.*] 1. All materials which of themselves do give colour are either red, yellow, or blue; so that out of them, and the primitive fundamental colour white, all that great variety which we see in dyed stuffs doth arise.

2. That few of the colouring materials, as cochineal, foot, wood, wax, woad, &c. are in their outward and first appearance of the same colour, which by the slightest distempers and solutions in the weakest menstrea, they dye upon cloth, silk, &c.

3. That many of them will not yield their colours without much grinding, steeping, boiling and fermenting, or corrosion by powerful menstrea, as red wood, weld, woad, arnotta, &c.

4. That many of them will of themselves give no colouring at all, as copperas or galls, or with much disadvantage, unless the cloth or other stuff to be dyed be as it were first covered, or incrustated with some other matter, though colourless aforehand, as madder, weld, brasil, with alum.

5. That some of them, by the help of other colourless ingredients, do strike different colours from what they would of themselves, as cochineal, brazil, &c.

6. That some colours, as madder, indigo and woad, by reiterated tinctures, will at last become black.

7. That although green be the most frequent and most common of natural colours, yet there is no simple ingredient now used alone to dye green with upon any material, sap-green being the nearest, which is used by country people.

8. There is no black thing in use which dyes black.

though both the coal and foot of most things burnt or scorched be of that colour, and the blacker, by how much the matter before being burnt was whiter, as in ivory-black.

9. The tincture of some dying stuffs will fade even with lying, or with the air, or will stain with water only, but very much with urine, vinegar, &c.

10. Some of the dying materials are used to bind and strengthen a colour; some to brighten it; some to give lustre to the stuff; some to discharge and take off the colour, either in whole or in part; and some out of fraud, to make the material dyed, if costly, heavier.

11. That some dying ingredients, or drugs, by the coarseness of their bodies, make the thread of the dyed stuff seem coarser; and some by shrinking them, smaller; and some, by smoothing them, finer.

12. Many of the same colours are dyed upon several stuffs with several materials, as red-wood is used in cloth, not in silks; arnotta in silks, not in cloth, and may be dyed at several prices.

13. That scouring and washing of stuffs to be dyed, is done with special materials, as sometimes with ox-galls, sometimes with fuller's-earth, and sometimes soap; this latter being, in some cases, pernicious, where pot-ashes will stain or alter the colour.

14. Where great quantities of stuffs are to be dyed together, or where they are to be done with any speed, and where the pieces are very long, broad, thick, or otherwise, they are to be differently handled, both in respect to the vessels and ingredients.

15. In some stuffs and colours the tingent liquor must be boiling, in other cases blood warm, and in some it may be cold.

16. Some tingent liquors are fitted for use by long keeping, and in some the virtues wear away by the keeping.

17. Some colours or stuffs are best dyed by reiterated dippings in the same liquor, some by continuing longer, and others a lesser time therein.

18. In some cases, the matter of the vessel wherein

the liquors are heated, and the tincture prepared, must be regarded, as the kettles must be pewter for bow-dye.

19. There is little reckoning made how much liquor is used in proportion to the dying drugs, it being rather adjusted to the bulk of the stuffs, as the vessels are to their breadth ; the quantity of dying drugs being proportioned both to the colour, higher or lower, and to the stuffs : as likewise the salts are to the dying drugs. Concerning the weight that colours give to silk (in which it is most taken notice of being sold by weight, and a commodity of great price), it is observed that one pound of raw silk loseth four ounces by washing out the gums, and the natural sordes. That the same seoured silk may be raised to above thirty ounces from the remaining twelve, if it be dyed black with some materials.

Of a thing very useful in dying, especially of black, nothing increases weight so much as galls, by which black silks are restored to as much weight as they lost by washing out their gum : nor is it counted extraordinary that blacks should gain about four or six ounces in the dying, upon each pound.

Next to galls, old fustic increases the weight  $1\frac{1}{2}$  in 12 ; madder, about one ounce ; weld, half an ounce. The blue vats in deep blues of the 5th stall, give no considerable weight ; neither doth logwood, cochineal, nor even copperas, where galls are not : slippe adds much to the weight, and giveth a deeper black than copperas itself, which is a good excuse for the dyers that use it.

*Dying of wool and woollen manufactures.*] For black in woollen manufactures, it is begun with a strong decoction of woad and indigo, that communicate a deep blue ; after which the stuffs being boiled with alum and tartar, or pot-ash, are to be maddered with common madder, then dyed black with Aleppo galls, copperas, and sumac, and finished by back boiling in weld. Wools for tapestry are only to be woaded, and then put in black. For scarlet, wool and woollen manufactures are dyed with kermes and cochineal, with which may

also be used agaric and arsenic. Crimson scarlet is dyed with cochineal, mastic, aquafortis, sal ammoniac, sublimate, and spirit of wine. Violet scarlet, purple, amaranth, and pansy scarlets, are given with woad, cochineal, indigo, braziletto, brazil and orchal. Common reds are given with pure madder, without any other ingredient. Crimson reds, carnations, flame and peach colours, are given, according to their several hues, with cochineal, mastic, without madder, or the like. Crimson red is prepared with Roman alum with cochineal. Orange aurora, brick colour, and onion peel colour, are dyed with woad and madder, mixed according to their several shades. For blues, the dark are dyed with a strong tincture of woad; the brighter with the same liquor, as it weakens in working. Dark browns, minims, and tan colours, are given with woad weaker in decoction than for black, with alum and pot-ashes, after which they are maddered higher than black: for tan colours, a little cochineal is added. Pearl colours are given with galls and copperas; some are begun with walnut tree roots, and finished with the former; though to make them more useful, they generally dip them in a weak tincture of cochineal. Greens are begun with woad, and finished with weld. Pale yellows, lemon colour, and sulphur colour, are given with weld alone. Olive colours of all degrees are first put in green, and taken down with foot, more or less, according to the shade that is required. Feulemort, hair colour, musk, and cinnamon colour, are dyed with weld and madder. Nacarat, or bright orange, is given with weld and goats hair boiled with pot-ashes.

*Dying of Silks.*] This is begun by boiling them in soap, &c. then scouring and washing them in water and steeping them in cold alum water. For crimson they are scoured a second time before they are put into the cochineal vat. Red crimson is given with pure cochineal, mastic, adding galls, turmeric, arsenic, and tartar, all mixed in a copper of fair water almost boiling: with these the silk is to be boiled an hour and half, after which it is allowed to stand in the liquor till



next day. Violet crimson is given with pure cochineal, arsenic, tartar and galls ; but the galls in less proportion than in the former : when taken out, it is washed and put in a vat of indigo. Cinnamon crimson is begun like the violet, but finished by back boiling, if too bright with copperas, and if dark, with a dip of indigo. Light blues are given in a back of indigo. Sky blues are begun with orchal, and finished with indigo. For citron colours, the silk is first alumed, then welded with indigo. Pale yellows, after aluming, are dyed in weld alone. Pale and brown auroras, after aluming, are welded strongly, then taken down with rocou and dissolved with pot-ashes. Flame colour is begun with rocou, then alumed, and afterwards dipped in a vat or two of brazil. Carnation and rose colours are first alumed, then dipt in brazil. Cinnamon colour, after aluming is dipt in brazil, and braziletto. Lead colour is given with fustic, or with weld, braziletto, galls and copperas. Black silks of the coarser sort, are begun by scouring them with soap, as for other colours ; after which they are washed out, wrung, and boiled an hour in old galls, where they are suffered to stand a day or two : then they are washed again with fair water, wrung, and put into another vat of new galls ; afterwards washed again, and wrung, and finished in a vat of black. Fine black silks are only put once into galls of the new and fine sort, that has only boiled an hour : then the silks are washed, wrung out, and dipped thrice in black, and afterwards taken down by back boiling with soap.

*The dying of thread.*] This is begun by scouring it in a lye of good ashes : afterwards it is wrung, rinsed out in river water, and wrung again. A bright blue is given with braziletto and indigo : bright green is first dyed blue, then back-boiled with braziletto and verditer, and lastly woaded. A dark green is given like the former, only darkening more before woading. Lemon and pale yellow is given with weld mixed with rocou. Orange flabella, with fustic, weld and rocou. Red, both bright and dark, with flame colour, &c. are given

with brazil, either alone, or with a mixture of rocou. Violet, dry rose, and amaranth, are given with brazil, taken down with indigo. Feulemort and olive-colour are given with galls and copperas, taken down with weld, rocou, or fustic. Black is given with galls and copperas, taken down and finished with braziletto wood.

*A preparation for curing Wens, by which a person has acquired a considerable fortune, and much reputation.*] Take a quantity of snow, that has been collected in the coldest season, sufficient to produce a quart of water, when melted: add to this one ounce of Roman vitriol, and one drachm of camphire; these are to be put in the snow water; after this is made warm over a moderate fire, let it stand till fine; and then add thereto four ounces of spirit of wine, in which one drachm of the golden or July butter-flies have been infused. These insects are to be dried and powdered, before they are put into the spirits of wine; and care must be taken to produce the right sort, as it appears that very much depends on them. They are to be had, in most places where flowers abound, about Midsummer; and are then in their prime. With this liquid the wens are to be rubbed night and morning for a month successively, and success will attend it, with very little pain or trouble to the patient. Snow, when used alone, is said to have many valuable properties; as may be seen at large in Bartholin's Treatise de nivis usu medico. It has been observed, in the cure of wens, that if the patient anoint the part with oil of sweet almonds three or four days before using the above remedy, it will greatly forward the cure.

*Method of colouring Brandy.*] All brandies, when first made, are as clear as water, and do grow higher coloured by long keeping; however, they are artfully made of any colour several ways. To make a light straw colour, use turmeric or a little treacle: but the best way is to give it a colour or tincture with a little burned sugar made to a consistence; or syrup of elderberries may be used, which gives an admirable colour, and may be made deeper or lighter, according to the quantity you put in.

*The way to make Sealing-wafers.*] Take very fine flour, mix it with glair of eggs, isinglass, and a little yeast; mingle the materials; beat them well together, spread the batter, being made thin with gum water, on even tin plates, and dry them in a stove; then cut them out for use. You may make them of what colours you please, by tinging the paste with brazil or vermillion for red; indigo or verditer, &c. for blue.

*Sympathetic powder.*] The composition of the famous sympathetic powder, used at Gossilaer by the miners in all their wounds, is this. Take of green vitriol, eight ounces; of gum tragacanth, reduced to an impalpable powder, one ounce; mix these together, and let a small quantity of the powder be sprinkled on the wound, and it immediately stops bleeding. The vitriol is to be calcined to whiteness in the sun, before it is mixed with the gum.

*The virtues of a crust of bread, eat in a morning fasting; published by an eminent physician.*] In the above treatise, (which sells for 7s. 9d.) the author only asserts, that a great many obstinate disorders, are cured by this simple remedy; and gives many instances of its great efficacy in the following cases. viz. king's evil, cachexies, scurvies, leprosies, rheumatic complaints, &c. The author orders about half an ounce of hard crust, or sea biscuit, to be eat every morning fasting, for five or six weeks; and nothing to be taken after it in less than three or four hours.

*To purify butter, and make it of a most sweet taste.*] Melt butter with a slow fire in a well glazed earthen vessel, which put to fair water, working them well together, and when it is cold take away the curds and the whey at the bottom. Do it again the second time, and if you please, the third time in rose-water, always working them very well together. The butter thus clarified will be as sweet in taste, as the marrow of any beast, and keep a long time, by reason of the great impurity which is removed by this means, the dross being near a quarter of the whole.

*Construction of Almanacks.*] The first thing to be done, is to compute the sun's and moon's place for each day of the year, or it may be taken from some ephemerides, and entered in the almanack; next, find the dominical letter; and, by means thereof, distribute the calendar into weeks: then having computed the time of Easter, by it fix the other immoveable feasts; adding the immoveable ones, with the names of the martyrs, the rising and setting of each luminary, the length of day and night, the aspects of the planets, the phases of the moon, and the sun's entrance into the cardinal points of the ecliptic; that is, the two æquinoxes and solstices. And these are the principal contents of almanacks; besides which there are others of a political nature, and consequently different in different countries, as the birth-days and coronations of princes, tables of interest, &c. As to the antiquity of almanacks, Duncange informs us, that the Egyptian astrologers, long before the Arabians, used the term almanack, and almenachica descriptio, for their monthly productions. Be that as it will, Regiomontanus is allowed to have been the first who reduced almanacks to their present form. On the whole, there appears to be no mystery, or even difficulty, in almanack making, provided tables of the heavenly motions be not wanting.

*A necessary POCKET ALMANACK, by which the day of the month is known, at first view, from the present time, to the year of our Lord 1831.*] Under the word years, find the year; above which is the dominical letter for that year.—Then, against the month, in the other table, find the same letter, over which are placed the days of the month for every Sunday of that month.—Every blank space shows the year following to be leap year.—N. B. In every leap-year for January and February, use the letter above the blank space before for that year.

## YEARS.

## SUNDAYS.

A	G	F	E	D	C	B	1	2	3	4	5	6	7	
1758	59		60	61	62	63		8	9	10	11	12	13	14
	64	65	66	67		68		15	16	17	18	19	20	21
69	70	71		72	73	74		22	23	24	25	26	27	28
75		76	77	78	79			29	30	31				
80	81	82	83		84	85	Jan. Oct.	A	B	C	D	E	F	G
86	87		88	89	90	91	May.	B	C	D	E	F	G	A
	92	93	94	95		96	Aug.	C	D	E	F	G	A	B
97	98	99	1800	1	2	3	Fb. Mar Nov.	D	E	F	G	A	B	C
	4	5	6	7		8	June.	E	F	G	A	B	C	D
9	10	11		12	13	14	Sep. De	F	G	A	B	C	D	E
15		16	17	18	19		Ap. Jul.	G	A	B	C	D	E	F
20	21	22	23		24	25								
26	27		28	29	30	31								

*To make an artificial Malaga wine.*] Take a wine vessel well hooped with iron hoops, and one end open, to which a close cover must be fitted to put on and take off at pleasure, set it in a warm place, fill it full of fair water, to every gallon of which put two pounds of Malaga raisins, first bruised in a stone mortar; and to every twenty gallons of water a good handful of calx vive: cover the vessel close, and keep it warm with cloths: let it stand four or five days to work: then see if the raisins be risen up, and beat them down, and co-



ver it again as before, beating them down every fourth or fifth day for three or four weeks: then put a tap in, four inches above the bottom, and see if it tastes like wine; if not, let it stand a while longer; after which draw it off into another wine vessel, and to every twenty gallons put a pint or quart of the best spirit of wine (as you would have it in strength) two new laid eggs, and a quart or better of Alicant well beaten together. Let it stand in a cellar as other wine till it is fine, and fit to be drank.

*To make an artificial claret.]* Take water, six gallons: choice cyder, two gallons: best Malaga raisins bruised, eight pounds: mix and let them stand all in a warm place fourteen days, stirring them well once every day. Then press out the raisins, and put the liquor into the vessel again, to which add juice of raspberries a quart: juice of black cherries a pint: juice of black berries a pint and a half: cover this liquor with bread, spread thick with strong mustard; the mustard side being downwards, and so let it work by the fire three or four days; after which turn it up, let it stand a week, and bottle it up, so will it become a very brisk and pleasant drink, and far better and wholesomer than our common claret.

*To make an artificial molnsey.]* Take eight gallons of spring water: honey two gallons: make them boil over a gentle fire for an hour: take it off, and when it is cold, put it into a runlet, hanging in the vessel a bag of spices, and set it in the cellar for half a year, at the end of which you may drink it.

*To make raspberry wine.]* Take Canary a gallon: raspberries two gallons: mix and digest twenty-four hours: strain them out, and add raisins of the sun stoned three pounds: digest again four or five days, sometimes stirring them together: then pour off the clearest, and put it up into bottles, which put into a cold place: if it be not sweet enough you may dulcify it with sugar.

*Another way to do the same.]* Take juice of raspberries, bottle it up close, and set it in a cellar, and it will

become clear, and keep all the year long, and be very fragrant; a few spoonfuls of this put into a pint of wine sweetened with sugar, will give it a full taste of the berry: two or three ounces of the syrup of the juice will do the same.

*To purify oil olive, that it may be eaten with pleasure.]* Take fair water two quarts, oil olive a pint: mix and shake them well together for a quarter of an hour in a glass; then separate the water from the oil with a separating funnel. Do this four or five times or more, as you see occasion, till the oil becomes very pure; and the last time wash it with rose-water, then hang in the midst of the oil a coarse bag full of bruised nutmegs, cloves, and cinnamon, so will you give it an excellent taste.

*To make sage, parsley, or pennyroyal butter.]* When the butter is newly made, and well wrought from its water, milk, and wheyish part, mix therewith a little oil of sage or parsley, so much till the butter is strong enough in taste to your liking, and then temper them well together; this will excuse you from eating the plants therewith; and if you do this with the aforesaid clarified butter, it will be far better, and a most admirable rarity.

*To purify and refine sugar.]* In a strong lixivium of calx vive dissolve as much coarse sugar as it will bear, adding to every quart of liquor, two whites of eggs, beaten into glair, stir them well together, and make them boil a little, taking off the scum, as long as any will arise; then pass all through a great woollen cloth bag, then boil the liquor again so long till being dropt upon a cold plate, being cold, it is as hard as salt; this done, put it out into pots or moulds for that purpose, having a hole in the narrower end thereof, which must be stopp'd for one night, afterwards being opened, the molosses or treacle will drop forth; then cover the ends of the pots with potters' clay, and as that clay sinks down, by reason of the sinking of the sugar, fill them up with more clay, doing thus, till the sugar will sink no more. Lastly take it out, and being hard and dry, bind it up in papers.

*To make a plant grow in two or three hours.]* Take ashes of moss, which moisten with the juice of an old dunghill (being pressed out and strained) then dry them a little, and moisten them as before; do this four or five times; put this mixture, not being very dry nor very moist, into an earthen vessel, and in it set seeds of lettuce, purslane, or parsley, (for they will grow sooner than other seeds) being first impregnated with the essence of a vegetable of its own species (some say the juice of the same plant, but especially the spi it will do instead of the essence;) till they begin to sprout forth; which then put into the said earth, with that end upwards which springs. Put the vessel into a gentle heat, and when it begins to dry, moisten it with the said juice of dung: thus may you have a sallad while supper is making ready.

*To reduce a whole vegetable into a liquor which may be called the essence thereof.]* Take the whole plant with flowers and roots, bruise them in a mortar, put all into a large glass vessel, (but a wooden one is better) so that two of three parts may be empty; cover it exceeding close, and let it stand in putrefaction in a moderate heat for a year, and it will all be turned into a water.

*To make the lively form and idea of any plant appear in a glass.]* Take the former water, of vegetable, distil it in a good glass in ashes, and there will come forth a water and oil, and in the upper part of the vessel a volatile salt; the oil separate and keep by itself; with the water dissolve the volatile salt, and purify it by filtering and coagulating. This purified salt imbibe with the said oil until it will imbibe no more; digest them well together for a month in a vessel hermetically sealed; so will you have a most subtle essence, which being held over a gentle heat, or the flame of a candle, by which means it may be made hot, you will see the fine substance (which is like impalpable ashes or salt) send forth from the bottom of the glass, the manifest form and idea of the vegetable, vegetating and growing by little and little, and putting on so fully the form of stalks, leaves, and flowers, in such perfect and natural wise,

that one would believe the same to be real; when as in truth it is the spiritual idea, arising with the spiritual essence of the plant; this, were it joined with its proper earth, would take to itself a more solid body. Now as soon as the vessel or glass is removed from the fire, this idea or representation vanishes, becoming a chaos and confused matter, returning to its sediment, from whence it arose.

*Another way to make the essence of a plant.]* Put the herbs, flowers, seeds, spices, &c. into rectified spirit of wine: extract a very strong and deep tincture, upon which put strong oil of salt, and digest in Balneo, till an oil swim above, which separate. Or else draw off the spirit of wine in Balneo, and the oil or essence will remain at bottom: but before the spirit of wine is abstracted, the oil or essence is blood red, and a true quintessence.

*Another way to make the true essence, or rather quintessence.]* Make the water, oil, and volatile salt, as before is taught; and from the faces extract the fixed salt, which purify according to art; which salt resolve in a cellar upon a marble stone to an oil, which is what we call per deliquium, filter it and evaporate, till the salt is white as snow, with these salts imbibe as much of the oil as you can make it receive; then digest till the oil will not separate from the salt, but become a fixed powder, melting with an easy heat.

*To make the form of a firr tree appear in Colophonia.]* Distil turpentine in a retort gradatim: when all is distilled off, keep the retort still in a reasonable heat, that what humidity is still remaining may be evaporated, and it become dry. Take it then off from the fire, and hold your hand to the bottom of the retort, and the turpentine which is dried, (called also colophonia or rosin) will crack asunder in several places, and in those cracks, or chaps, you shall see the perfect figure of firr trees, which will there continue many months.

*To make hartshorn seemingly grow in a glass.]* Take hartshorn broken into small bits, and put them into a glass retort to be distilled, and you shall see the glass

to be seemingly full of horns ; which will continue there so long, till the volatile salt be come over.

*To make a durable and lasting oil.]* 1. Take unslacked lime, bay salt, oil olive, of each a like quantity ; mix them well together, and distil in sand : cohobate the oil upon the same quantity of fresh lime and salt ; this do four times. 2. The oil by this means will be clear, and impregnated with what salt was volatile in the lime and salt. 3. If it be seven times distilled, it will be as pure, odoriferous, and subtle, as many distilled oils of vegetables. 4. This oil whilst distilling, has a most fragrant smell, and of a most durable quality, which durability comes from the saline impregnation ; besides which, it is good against any inveterate ache or pain in the limbs, or other parts. 5. A lamp made with this oil, will burn six or seven times as long, as that which is made with other oil ; also it burns very sweet. 6. You ought to be very cautious in making of it, or else your glasses will quickly break. 7. You must take very strong lime, such as your dyers use, and call Cauk.

*To make a candle that shall last long.]* Mix with your tallow unslacked lime in powder ; or make your candles of castile-soap : such candles as these will be admirable for lamp furnaces. Now it is the salt in the lime and soap, that preserves the tallow from burning out so fast, as otherwise it would.

*To make the distilled oil out of any herb, seed, flower, or paper, in a moment, without a furnace.]* You must have a long pipe made of tin, or tobacco-pipe clay with a hole in it as big as a small walnut, three or four inches from one end of it, into which you must put the matter, you would have the oil off ; set it on fire with a candle or a coal ; then put one end of the pipe into a basin of fair water, and blow at the other end, so will the smoak come into the water, and the oil will swim upon it, which you may separate with a funnel.

*To reduce rosin into turpentine again.]* Take oil of turpentine and the colophonia, or rosin thereof, in powder ; mix these together, and digest them, and you



shall have turpentine of the same consistency it was before ; but of a more fiery and subtile nature : pills made thereof are more excellent for opening obstructions of the breast, lungs, kidneys, bowels, &c. than those that are made of raw turpentine.

*To write or engrave upon an egg, pebble, flint, &c.]*

Write what you please with wax or grease upon an egg, pebble, flint, &c. then put it into the strongest spirit of vinegar, or oil of salt, letting it lie two or three days ; and you shall see every place about the letters or writing, eaten or consumed away ; but the place where the wax or grease was not at all touched.

*To make a powder, which being wetted shall be kindled.]*

1. Take a load-stone, powder it, and put it into a strong crucible ; cover it all over with a powder made of calx vive and colophonia, of each a like quantity ; put also some of this powder under it : when the crucible is full, cover it, and lute the closures with potters' earth, put it into a furnace, and there let it boil ; after take it out, and put the matter into another crucible, and set it in a furnace also, this do till it becomes a very white and dry calx. 2. Take of this calx one part ; sal nitre well purified four parts ; and as much camphire, sulphur vive, oil of turpentine and tartar ; grind what is to be ground to a subtile powder, and put all into a glass vessel, with as much well rectified spirit of wine, as will cover them two inches over. 3. Stop the vessel close up, and set it in horse-dung three months, so will all the matter become an uniform paste : evaporate all the humidity, until the whole mass becomes a very dry stone ; which take out, powder it, and keep it very dry. 4. If you take a little of this powder, and spit upon it, or pour some water thereon, it will take fire presently, so that you may light a match, or any such thing by it.

*To make a room seem to be on fire.]* Take rectified spirit of wine, and dissolve camphire therein ; evaporate this in a very close chamber, where no air can get in ; and he that first enters the chamber with a lighted candle, will be amazed ; for the chamber will seem to be full of fire, and very subtile, but of little continu-

ance. This done in a close cupboard or press, will be much more perspicuous and visible.

*To make the four elements appear in a glass.]* Take jet in fine powder an ounce and half: oleum tartari per deliquium (made without addition of any water) two ounces, coloured with a light green with verdigrise: add thereto spirit of wine tinged with a light blue with indigo, two ounces: of the best rectified spirit of turpentine, tinged of a light red with madder, two ounces: mix all these in a glass, and shake them together, and you shall see the heavy black jet fall to the bottom, and represent the earth: next the oil of tartar made green falls, representing the water: upon that swims the blue spirit of wine, representing the air or sky; and uppermost of all will swim the subtile red oil of turpentine, representing the element of fire. It is strange to see how after shaking all these together, they will be distinctly separated one from another. If it be well done, (as it is easy to do it) it is an admirable and glorious sight.

*To represent the whole world in a glass.]* Take the finest sal-astre, what you please; tin, half so much; mix them well together, and close them hermetically: then put them into a retort, to which adjoin a glass receiver, with leaves of gold put into the bottom thereof; lute them well together; put fire to the retort, until vapours arise that will cleave to the gold: augment the fire till no more fumes ascend; then take away the receiver; close it hermetically, and make a lamp fire under it: and you will see represented in it, the sun, moon, stars, fountains, trees, herbs, plants, flowers, fruits, and indeed, even all things, after a very wonderful manner.

*To make regulus of antimony, for antimonial cups.]* Take antimony in powder, nitre, of each a pound: crude tartar in fine powder, two pounds; mix, put them into a crucible, cover the crucible, and melt, so will the regulus fall to the bottom, which pour into a brass mortar smeared with oil. Or thus: Take antimony powdered, two pounds; crude tartar in powder

four pounds; melt as before. This regulus you may cast into cups, pictures, medals, or what figures you please: these infused into two or three ounces of wine in an earthen glazed vessel, or in a glass, in a gentle heat all night, gives you a liquor in the morning which will vomit: dose, from two drachms to two ounces and a half; you may sweeten it if you please with a little white sugar. These cups or pictures will last for ever, and be as effectual after a thousand times infusion as at first.

*To make Barbers' wash balls.]* Take purified Venetian soap six ounces, macaleb four ounces, ireos, amyllum, of each seven ounces, cloves two ounces, labdanum, anniseeds of each one ounce, nutmegs, majoram, Cypress powder, geranium moschatum, camphire, of each half an ounce, storax liquida half a drachm, musk ten grains, all being in fine powder, with a little fine sugar, beat all in a mortar, and make them up into wash balls.

*To make common wash-balls, the best of that kind.]* Take Venice or Castile-soap sliced very thin, four pounds, spirit of wine half a pint, beat all together; then add chemical oil of saltstalls or lemons an ounce or more; and beat again very well: lastly, add white starch made into a paste with water, by boiling a sufficient quantity to make all into an even and smooth mass, which form into balls of four ounces a piece, with powder of white starch, dry them and keep them for use.

*To make unguentum pomatum, or ointment of apples.]* Take hog's lard three pounds, sheep's suet nine ounces, bruised cloves one drachm, aqua rosarum two ounces, pomwaters pared and sliced one pound, boil all to the consumption of the rose-water; then strain without pressing, to every pound of which add oil of rhodium and cinnamon, of each thirty drops.

*To make a compound pomatum.]* Take of the pomatum aforesaid (without the oils) four pounds, spicknerk, cloves, of each two ounces, cinnamon, storax, benjamin, of each one ounce, (the spices and gums bruised and tied up in a thin rag) rose-water, eight ounces; boil to the consumption of the rose-water, then add

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white wax eight ounces, which mix well by melting, strain it again being hot ; and when it is almost cold mix therewith oil of musk, then put it out, and keep it for use.

*To cleanse the Skin.]* Wash with warm water, and sweet scented wash balls very well ; then rub the skin with a cloth, and wash well with water in which wheat-bran has been boiled—Or thus, take sublimate one ounce, glair of six eggs, boil them in a glass vessel, till they grow thick, then press out the water, with which wash the skin.

*To make the skin soft and smooth.]* The skin being very clean, as before directed, wash it very well with a lixivium of salt of tartar, and after that anoint it with pomatum ; or which is better, oil of sweet almonds, doing this every night going to bed.

*A water to cleanse the face from scurf and morpew.]* Take distilled rain water six ounces, juice of lemons twelve ounces, mix them, and wash with it morning and evening, anointing after it at night going to bed with the oil or pomatum aforesaid.

*An unguent which brings the skin to an exquisite beauty.]* Take of pomatum one ounce, salt of tartar one drachm, musk twenty grains, mix them well, and (the face or skin being very clean) anoint morning and evening.

*To make the hair lank and slag that curls too much.]* Anoint the hair thoroughly twice or thrice a week with oil of lilies, roses, or marsh mallows, combing it after it very well.

*To make the hair grow long and soft.]* Distil hog's grease or oil of olive in an alembic ; with the oil that comes therefrom anoint the hair, and it will make it grow long and soft : use it for use.

*To preserve the hair from splitting at the ends.]* Anoint the ends thereof with oil omphacine, or oil of myrtles ; they are eminent in this case to preserve the hair from splitting, so also an ointment made of honey, bee's-wax, and oil omphacine, or bear's grease.

*A sweet powder to lay among cloaths.]* Take damask-rose leaves dried one pound, musk half a drachm, violet


leaves three ounces, mix them and put them in a bag  
*Another for the same, or to wear about one.*] Take  
 rose leaves dried one pound, cloves in powder half an  
 ounce, spicknard two drachms, storax, cinnamon, of  
 each three drachms, musk half a drachm, mix them  
 and put them into bags for use.

*An excellent perfuming powder for the hair.*] Take  
 iris roots in fine powder one ounce and a half, benja-  
 min, storax, cloves, musk, of each two drachms : being  
 all in fine powder, mix them for a perfume for hair-  
 powder. Take of this perfume one drachm, rice-flower  
 impalpable one pound, mix them for a powder for the  
 hair. Note, some use white starch, flower of French  
 beans and the like.

*A perfume to smooke and burn.*] Take labdanum two  
 ounces, storax one ounce, benjamin, cloves, mace, of  
 each half an ounce, musk, civet, of each ten grains, all  
 in fine powder, make it up into cakes with mucilage of  
 gum tragacanth in rose-water, which dry ; and keep  
 among your cloaths, which when occasion requires, you  
 may burn in a chafing-dish of coals.

*To make red writing ink.*] Take raspings of Brazil  
 one ounce, white lead, alum, of each two drachms,  
 grind and mingle them, infuse them in urine one pound,  
 with gum arabick two scruples, or a drachm at most.

*Another way to make red ink.*] Take wine vinegar  
 two pounds, raspings of Brazil two ounces, alum half  
 an ounce, infuse all ten days ; then gently boil, to  
 which add gum arabick five drachms, dissolve the gum,  
 strain and keep it for use. Note, two drachms of the  
 gum in some cases may be enough.

 I forbear here to give a receipt for preparing a  
 most exquisite *Black Writing Ink*, having sold the pro-  
 perty of it to WILLIAM SPOTSWOOD, Printer and Book-  
 seller, Philadelphia, who intends shortly to offer it to  
 the public ready prepared, at the same rate of the or-  
 dinary sort of black ink. It is free from the ill qualities  
 of the common black writing ink. I had it from a late  
 eminent and much celebrated chemist.



*To make green ink to write with.]* Make fine verdigrise into paffe with strong vinegar, an infusion of green galls, in which a little gum arabick hath been dissolved, let it dry, and when you would write with it, temper it with infusion of green galls aforesaid.

*Another way to make green ink to write with.]* Dissolve verdigrise in vinegar, then strain it, and grind it with a little honey and mucilage of gum tragacanth, upon a porphyry stone.

*To make blue ink to write with.]* Grind indigo with honey mixed with glair of eggs or glue-water, made of isinglass dissolved in water and strained.

*To make red writing ink of vermillion.]* Grind vermillion well upon a porphyry stone, with common water; dry it and put it into a glass vessel, to which put urine, shake all together, let it settle, then pour off the urine, and putting on more urine, repeat this work eight or ten times, so will the vermillion be well cleansed; to which put glair of eggs to swim on it above a finger's breadth, stir them together, and settling abstract the glair; then put on more glair of eggs, repeating the same work eight or ten times also, to take away the scent of the urine: lastly, mix it with fresh glair, and keep it in a glass vessel close stopped for use. When you use it, mix it with water or vinegar.

*To make printer's black.]* This is made by grinding the best lamp black with liquid varnish, and boiling it a little, which you may make thick at pleasure. You must make it moister in winter, than in summer; and note, that the thicker ink makes the fairer letter. If it be too thick, you must put in more linseed oil, or oil of walnuts, so may you make it thicker or thinner at pleasure.

*To make red printing ink.]* Grind vermillion very well with the aforesaid liquid varnish or linseed oil.

*To make green printing ink.]* Grind Spanish green with the said varnish or linseed oil as aforesaid; and after the same manner, may you make printer's blue, by grinding azure with the said linseed oil.

*To make red soft wax.]* Take white bee's-wax one

pound, turpentine three ounces, vermillion in powder well ground, oil olive, of each one ounce, melt the wax and turpentine; let it cool a little, then add the rest, beating them well together.

*To do the same otherwise.]* This is done by taking away the vermillion, and adding instead thereof red lead three ounces, to the former things.

*To make green wax.]* Take wax one pound, turpentine three ounces, verdigrise ground, oil olive, of each one ounce; complete the work as before directed.

*To make black wax.]* Take bee's-wax one pound, turpentine three ounces, black earth, oil olive, of each one ounce; mix and make wax as aforesaid.

*To make wax perfumed.]* This is done by mixing with the olive aforesaid, musk, ambergrise, or any other eminent perfume, as oil of cinnamon, adeps rosarum, or the like, one drachm, more or less, according as you intend to have its scent extended.

After the same manner you may make soft wax of all colours, having what scent you please; by mixing the scent intended, with the oil olive, and putting the colour in, in place of the vermillion.

*To make hard sealing wax.]* Take pure fine gum-lack, melt it in an earthen vessel, and put into it a sufficient quantity of the colour you design your wax to be of, stir and mingle it well, then take it off the fire, and when it is a fit heat, you may make it up into rolls or sticks. To make red wax, you must colour it with vermillion. Blue wax, with blue bice, smalt, or ultramarine. Green wax with green bice, verdigrise, or some other mixture of that colour. Black wax, with ivory or cherry stone black. Purple wax, or of a dark red, with prepared caput mortuum, Indian lake, &c.

*A strong glue for pipes and aqueducts.]* Tobacco pipe clay, dried and reduced to powder, and mixed with good store of short flocks, and beat up with linseed oil to a stiff paste, like kneaded dough, makes a strong and a lasting cement for pipes and aqueducts; and being made into pipes (though long a drying) is very staunch and lasting.

*To make a very strong glue.*] Soak the finest ichthyocolla (that is isinglass) twenty-four hours in spirit of wine, or common brandy; then boil all very gently together, continually stirring of it, that it burn not, so long till it becomes one liquor or body (save some strings not very dissolvable) which strain whilst hot, through a coarse linen cloth, into a vessel where it may be kept close stopped; a gentle heat will melt this glue into a transparent liquor, with which you may glew things so strongly together, that they will rather break in any other part, than in the place glued; it much exceeds the common glue.

*To make artificial pearls.*] Take sublimate two ounces, tin-glass one ounce, mix them, and sublime them together, and you will have a sublimate not inferior to the best orient pearls in the world, of which, with glair, you may form what you please.

END OF THE SECOND PART.

THE  
GOLDEN CABINET:  
BEING THE  
LABORATORY,

OR  
HANDMAID to the ARTS.

CONTAINING  
*Such Branches of Useful Knowledge,*

As nearly concerns all Kinds of People,

From the SQUIRE to the PEASANT:

AND WILL AFFORD BOTH  
PROFIT and DELIGHT.

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PART THE THIRD.

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PHILADELPHIA:

PRINTED AND SOLD BY WILLIAM SPOTSWOOD,  
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1793.

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T H E

S C H O O L of A R T S.

Of the nature and composition of GLASS:  
and the art of counterfeiting Gems of  
every kind.

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P A R T   T H E   T H I R D.

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*Of Glass in general.*

**B**Y glass, as here treated of, is to be understood, the artificial vitrifications of bodies, made to answer some useful purpose, either in domestic necessities, or other articles of commerce: and the observations and directions given with regard to it, in this treatise, are such only as respect the improvement of the art of preparing and compounding the kinds applicable to these ends in the different manufactures of it. For the more speculative and philosophic disquisitions on its nature are avoided, where they lead to no principles that are capable of being applied to practice. The methods of modelling and forming it into all the variety of vessels, and other figures, into which it is wrought are likewise omitted: because they are already, or may be by other means, well known to those who have any concern with them as an employment; or like all other occupations of artisans, may be much more easily and better learned by such as are desirous to be initia-

ted into an operative knowledge of them, from an inspection of actual works, and trials to imitate what is there to be seen done, than they can by the most explicit verbal directions.

The manufactured glass at present in use may be divided into three general kinds, white transparent glass, coloured glass, and common green or bottle glass. Of the first kind, there is a great variety of sorts, according to the several purposes intended to be served by it, either for making domestic utensils, or lights for inclosed places: and of the second, there is likewise a still greater multiplicity of species, differing in their colour, or other properties, according to the occasions for which they are wanted: but of the last, there is no distinguished difference of sort; except what the accidental manner of preparation and management, practised according to the skill or art of particular directors of manufactories, may occasion.

In order, however, to speak more intelligibly of the nature of the manufactured glass, to be here treated of, it is proper to give some distinct notion of vitrification in general. But I shall not endeavour to push the matter to those almost metaphysical lengths to which Bacher, Stahl, and others, have endeavoured to carry it, even far beyond the conclusions which can be supported by inductions from sufficient experiments. Vitrification then (according to the more general and obvious notions of its nature) is a change which may be wrought in most kinds of fixed bodies, or rather in all under some circumstances, by the means of heat, applied in various degrees, according to the various nature of the bodies from which change, they become fluid; and continue so while kept in the same, or any greater degree of heat; and, when become cold, acquire transparency, fragility, a great but not absolute degree of inflexibility, a total want of malleability, and insolubility in water. All these qualities are inseparably attendant on perfect vitrification: though there may be many preparations of artificial glass, even among those that are in common use, in which some of them are wanting.

But this is, nevertheless, only where the vitrification is immature; or where there is an admixture of other bodies with the vitrified matter: as in the case of the opaque white glass; in which the matter giving the milky colour is in an unvitified state, and consequently destroys the transparency; or, in the compositions where too great a proportion of salts is used, when the glass produced will be soluble in water, though perfect with respect to all the other qualities. In both these cases there is the presence of an heterogenous body, besides the proper glass; and therefore, if the whole mass be considered as if in a vitrified state, it must be deemed to be an imperfect one, though the composition, in the instance of the white glass, be adapted by this very circumstance to the æconomical purpose for which it is intended. The same principle will be verified on a due examination in all the other sorts of manufactured glass, as well as in accidental commixtures, where the appearances of the glass disagree with the system of qualities required, in the above given definition, to the perfect constitution of glass.

From the nature of vitrification, it therefore appears, that all fixed bodies are capable of being the materials of perfect glass under some circumstances. But as the means of vitrification are limited with regard to the manufactured glass, such bodies only are proper to become the ingredients of the perfect kinds of it, as are easily to be procured in due quantity, and admit of being vitrified by the heat of a furnace either alone, or by their commixture with others, which may promote this change in them: and in the case of the imperfect sorts, such as that above-mentioned, bodies that are not capable of being vitriated, by the means there employed, are also taken in as materials: where they are required to give the particular properties wanted in each peculiar sort. The principal substances, therefore, that are chosen for the composition of manufactured glass, are sand, flints, and other fassible bodies of a stony and earthy texture; metals and semi-metals of all kinds previously prepared by calcination, or other operations; arsenic and zaffer,

which are prepared parts of a fossile ; and all salts of a fixed kind.

Among these substances there are some which are strongly reluctant to the vitreous fusion, and could scarcely alone be ever converted to glass ; at least not by the heat of any furnaces ; and yet are such, as are most capable of giving firmness and tenacity to that in which they are admitted ; as also of being more copiously provided at a small expence. There are others, on the contrary, that vitrify in a much less heat than that commonly employed in the working of glass ; and have likewise this attendant property along with their own proneness to vitreous fusion, that they accelerate and produce it in many of those that are otherwise more repugnant to it ; and cause them, by their commixture, to vitrify in a greatly less degree of heat than they otherwise would. This property of promoting vitrification is called technically *fluxing* the bodies on which they so act ; and on the proper application of this principle to practice lies the main stress of skill in the art of compounding glass ; as the savings in the original cost of the ingredients, in time and in fuel, as well as the qualities of the glass produced, depend chiefly on the thorough intelligence, in this view, of the nature of the bodies, proper to become ingredients of it. The next important relation, in which bodies stand with respect to the composition of glass, is the effect they may have on its colour by their admixture : in order to destroy all kinds of which in some cases, and to produce them in others, ingredients are frequently added, that are not otherwise necessary ; as being no way subservient to the general view. This constitutes, therefore, the other great object of skill in the art of making glass : for the knowing properly how to take away all colour from the transparent white glass, and to impart any kind desired, to proper compositions on other occasions is of the next great moment to the being able, by the most cheap and easy means, to procure a due vitrification.

According to the above specified intentions, in which the several substances serving for the materials of glass

are used, they may be properly distinguished into three kinds, as making the body, flux, and colorific matter.

The substances which have been employed in forming the body of glass are sand (by which is only to be understood the white kinds) flints, talc, spar, and several other stony fossils. All these vitrify of themselves too slowly, to produce perfect glass by the degree of heat that can be applied to them when in larger masses : which makes them therefore require the addition of those other kinds, whose fluxing power may remedy this defect in them : while they, on the other hand, being of low price, and to be procured in unlimited quantities, and giving that hardness, strength, and insolubility, which cannot be had in any glass, formed of other substances without them, are yet essential and indispensibly necessary ingredients in all kinds of manufactured glass.

The substances which are used as fluxing ingredients in glass, are red-lead, pearl-ashes, nitre, sea-salt, borax, arsenic, the scoria of forges, commonly called clinkers, and wood-ashes, containing the calcined earth and lixivate salts, as produced by incineration. The presence of some of these bodies is always equally necessary with that of those which form the body, in all the compositions of manufactured glass. But the use of them, both with respect to choice and proportion, is greatly varied in different works ; even where the same kind of glass is intended to be produced : as the general nature of them has never been hitherto understood by the directors of such works ; and they have only implicitly followed the best receipts they could procure, carefully keeping them secret, when they happened either by communication or their accidental discovery to be possessed of such improvements, as gave them any advantages over their fellow operators.

The substances which have been applied as colorific matter in manufactured glass, are extremely numerous and various ; as all the species of metals and semi-metals, with many other mineral and fossile bodies, have been used for the producing some colour or other ; and make a large field of speculative and practical knowledge.



The art of staining glass, with all the variety of colours in the greatest degree of force and brightness, is not however of so much importance commercially considered, as the knowing how to banish and exclude, with ease and certainty, the colours which of themselves arise in most of the compositions for glass intended to be perfectly transparent and colourless. For this last purpose, nitre and magnesia are the principal substances employed, in the manufactures of G. Britain; and extremely well answer the end: though not without enhancing the expence of the glass by the use of the first; and in a small degree injuring its transparency by that of the latter: as may be demonstrated by principles that are unquestionable in themselves, though wholly unknown to those who are practically concerned in these matters.

From these three kind of substances, duly combined together by commixture and adequate heat, or in some cases from the two first only, all the sorts of manufactured glass at present in use are formed. The general manner of doing which, is to reduce those kinds of bodies, that are in grosser masses, to powder; and then, all the ingredients being thoroughly well mixed together by grinding, and put into proper pots, to place them in a furnace where the heat is sufficient to bring them to a due state of fusion; in which they are to be continued till the vitrification be completed.

This proper degree of vitrification must be distinguished by the transparent and equal appearance of the matter, when a small portion is taken out and suffered to cool: except in the case of those sorts where the glass is not perfect, with regard to which, a judgment must be made from their having attained or wanting that peculiar appearance, which the particular sort is required to have. It may be proper to subjoin, that in all cases, the vitrification is sooner and more easily made perfect in proportion as the ingredients are reduced to the state of a finer powder, and more intimately commixt.

*Of the materials serving for the body of glass.]* The materials employed to give a body to glass, are sand,

flints, talc, spar, and some other stony and terrene fossils.

Sand is, at present, almost the only kind of substance which is used in this intention in the British manufactures of glass; and with great reason, as it extremely well answers the purpose; and does not demand the previous preparation of calcination, that is necessary with respect to flints and other stones; and as it can be with certainty procured in any quantity demanded. The kind of sand most fit for making the white transparent kinds of glass, is that brought from Lynn in Norfolk, by the name of which place it is distinguished: and there is also another kind of this, but inferior, brought from Maidstone in Kent. It is white and shining; and examined by means of a microscope, appears to be small fragments of rock crystal; from which it does not seem, by any experiments, to differ in its qualities; and the glass formed of it may, therefore, properly be considered as made of crystal. The introduction of the use of it into the manufactures of glass in this country has almost wholly superseded that of flints: from which it no way differs in this application, but in the being somewhat slower in vitrifying; which makes it require in proportion a greater strength of flux and fire: but to compensate for this disadvantage, it is clearer in its own colour, and much freer from heterogeneous tinging bodies, which injure the colour of the glass; and frequently give embarrassment where flints are used. The sand requires no previous preparation for common and grosser purposes; especially where nitre is used; which burns out the sulphureous matter from any filth of the nature of animal and vegetable substances; and consequently calcines them to an earth no way injurious to the glass: but for nicer purposes, and where no nitre is used, it is proper to purify or cleanse the sand by washing: which may be thus done. Pour water upon it; and, having stirred them well about, incline the vessel immediately, in such manner, that the water may run off, and carry with it the filth that will float in it: by repeating which a few

times, the sand will be freed from all the heterogeneous matter that is lighter than itself. For coarse glass, other kinds of sand of a softer texture are used: as, besides the advantage of being cheaper, they are more easily vitrifiable than flints; and consequently make a saving in the fluxing bodies which are to be added to them.

Flints are the next important article in the substances which are used for forming the body of glass; and where indeed the only kind employed in larger works, where any better sorts of glass were manufactured, before the use of the white sand excluded them in all places where it is to be conveniently obtained. Since, for the reasons above given, it is a more eligible material, unless for experiments, or where very small quantities are required; in which case the calcined flints being more easily reduced to an impalpable powder, may possibly be more commodiously employed than the sand. Flints yet, however, continue to be used wherever the proper sand cannot be procured at a reasonable charge, as the sole ingredient for forming the body of the better kind of glass: since they are, in most places where they are naturally found, to be had in extreme great quantities; and the expence of calcining them does not enhance their whole cost to a degree beyond what the current price of glass may bear. The goodness of flints with respect to this use of them must be distinguished by their clear transparent black colour; and all such as are marbled with brown or yellowish colour should be rejected, for fear of iron, which frequently lurks in them under that appearance, and is very injurious to the colour of glass if it get admission into it. Such should, therefore be carefully picked out when found in parcels of the clearer sort; but if the greater part of any parcel appear so marked, it should not be used till trial be made in a small quantity, whether the discolouring be owing to any substance detrimental to the colour of glass or not. It is always necessary, that flints should undergo a calcination before they be used in the composition of glass: as well because they are not otherwise to

be reduced to a texture, which will admit of their being powdered, in order to their due commixture with the other ingredients; as because they are not susceptible of vitrification till a proper change may be produced in them by calcination. This calcination must be performed by putting them into a furnace of a moderate heat, being first dipped in water; and continuing them there till they become entirely white, even to the most interior part: which will require a greater or less time, according to their magnitude, and the degree of heat of the furnace. When they are thus rendered white, they must be taken out of the fire; and instantly immersed in cold water; where they must remain, till they be again cold: and then they will be found, if duly calcined, to be cracked and shivered into flaky pieces; and to become so softly brittle as to be easily reducible to powder. Some part will nevertheless be always found insufficiently calcined; which may be distinguished by their harder and more obdurate consistence: and they must be carefully separated, in order to be re-calcined; as they will otherwise greatly retard and impede the powdering of the duly calcined parts. Those which are properly calcined must then be levigated, by means of mills or other implements, accordingly as the quantity or opportunity may make it expedient; and they will then be fit for using in the composition for glass.

Talc of various species has been likewise used in the same intention as sand and flints: but seldom in large works. It sometimes requires a calcination, in order to its due preparation for entering into the composition of glass: but neither so great a heat, nor the quenching in cold water, are necessary for bringing it to a proper texture to bear powdering. Some sorts of talc are much more quickly vitrifiable than others; and, fusing easily with either salt of tartar or lead, may therefore be used in default of flint, or sand sufficiently white. But, with respect to larger manufactures, the use of flints is more eligible; as they are to be procured in great quantities with more certainty; and will, in

general, require much less flux and fire to bring them to a due state of vitrification.

Several other, both earthy and stony, fossils have been likewise used for forming the body of glass: and it has been observed, that most kinds of stony substances, which will scintillate or strike fire with steel, are vitrifiable within the degree that fits them for this purpose. But as they are neither used at present, nor promise to be any way advantageous in practice, as far as is hitherto known of them, I shall omit enumerating them; as being foreign to the purpose in hand: except with respect to two kinds. The one of these is called *meilon* by the French; and is found in great quantities, as an upper crust in many freestone quarries: and, as it may be used without any previous preparation, and is very quickly vitrifiable, may be serviceable, on some occasions, to those who may want to form glass, or vitreous compositions, where this may be procured with more ease than any of the before-mentioned substances. The other is the white round semi-transparent river pebbles, which vitrify very soon; and, if chosen colourless, make a very white glass; but they must be calcined, as the flint, by putting them into the fire till they be red hot; and then quench them in cold water, in order to bring them to a state fit to undergo powdering.

Kunkel confounds the calcined flints, and all other stones used for making glass, under the name of sand, in his receipts; notwithstanding he admits of a great difference in their readiness to be vitrified: as in the case of calcined flints, and the softest kind of natural sand; where one hundred and forty pounds of salt are required to a hundred and fifty pounds of the calcined flints, and only one hundred and thirty pounds of salt to two hundred pounds of the sand.

*[Of the materials used as fluxes in the composition of glass.]*

The materials used for the fluxes in the composition of manufactured glass, are, lead, pearl-ashes, nitre, sea salt, borax, arsenic, smith's clinkers, and wood-ashes,



containing the earth and lixivate salts as produced by incineration.

Lead is the present most important flux in the British manufactures of what is called flint glass: but it must be brought, by previous calcination, to the state of minium, or what is called red lead. This, used in a due proportion, makes a tougher and firmer glass than can be produced from salts alone: and is yet procured at a very small expence. But all the glass formed of lead is tinged originally with yellow; and therefore requires the addition of nitre to burn and destroy the sulphur or phlogistic matter it contains, in order to bring it to a more colourless state: which addition of nitre enhances again the cost of glass so composed, that would otherwise be extremely low. There is another reason, likewise, for the addition of nitre, or some other salt, to operate as a flux in the glass compounded with lead; which is, that there may not be a necessity of using beyond a certain proportion of it. For, if glass have much lead in its composition, it will suffer a corrosion by the air; which gives a greyish dulness to its surface, that is very injurious both to its beauty and utility. It is needless here, to teach the manner of calcining lead; because it is done in works appropriated to that purpose; and is sold by the proprietors of these works, at a cheaper rate than any particular persons could pretend to manufacture it for their private use. The perfection of red lead lies in its being thoroughly well calcined; which is best distinguished by its redness, inclining to crimson, and in its being pure; which may be adjudged of by the brightness of its colour. There is indeed no materials of a red colour cheap enough to adulterate it with, except powdered bricks, or some of the red okres; and they would immediately shew themselves, in the vitrification of the smallest quantity, by the strong yellow tinge they would give the glass.

Pearl-ashes is the next leading article among the substances used as fluxes in glass: and they at present mostly supply the place of the Levant-ashes, the barillas of Spain, and many other kinds, which were formerly

brought here, as well for making glass as soap. In the kinds of glass, where perfect transparency is wanted, as in looking-glass plates, and all kinds of window glass, salts are preferable as a flux to lead ; and, consequently, the pearl-ashes become the principal matter of the flux. For, as all the lixivate or fixed alkaline salts of vegetables are the same for this purpose, when pure, and those called pearl-ashes are purer than any other which can be provided at a moderate expence, the use of them is more expedient than of any other. This kind of fixed alkaline salts, called pearl ashes, is prepared in Germany, Russia, and Poland, by melting the salts out of the ashes of burnt wood ; and, having reduced them again to dryness, evaporating away the moisture, and calcining them for a considerable time in a furnace moderately heated. But, as they cannot be prepared with advantage in this country, (tho' in America they unquestionably might, and indeed are of late) and are to be had at a reasonable price by those who may have occasion to use them in making glass. I shall wave entering more particularly here into the detail of the process, by which they may be best and most profitably produced ; as not properly falling within the intention of this work. The goodness of pearl-ashes must be distinguished by the equal and white appearance of them ; as it consists in their purity, and their having been calcined for a long space of time, of which the whiteness, and equal appearance, are marks ; unless in the case of some parcels that contain lumps of a bluish cast produced by the calcination ; which discolouring is not, however, any proof of their being bad : but any brownish cast in particular parts, or greyness in the whole, is a certain criterion of their not being good. This must, however, be confined to such as are perfectly dry ; which can only well be on the opening the casks they are brought over in : for, if the air have access to them, they soon deliquesce, and look brown or greyish, from a semi-transparency they acquire in that deliquating state. There is one, and the most common adulteration, which is made in these salts, that is not easily

distinguishable by the appearance ; it is, the addition of common or sea salt, to them ; which is sometimes copiously made. This is not, however, very detrimental in the application of them to the forming glass. But it is, nevertheless, a disadvantage considerable enough in large concerns, to buy one thing for another at six times its current price. As it is expedient, therefore, to know how to distinguish this fraud, the following method is proposed as easy and certain.

Take a small quantity of the salt suspected ; and, after it has lain in the air so as to be a little softened but not melted, put it in a fire shovel and hold it over the fire where the heat is pretty strong. If it contain any common salt, a crackling, and, as it were slight explosion will follow, as the salt grows hot : which decrepitation is a certain mark of common salt wherever it is found.

The pearl-ashes require no preparation ; except where extreme great transparency is required, as in the case of looking glass, and the best window-glass ; in which cases a purification is necessary, in the manner which will be shown in speaking of these particular kinds.

Nitre in its refined state, in which it is commonly called salt petre, has been formerly much used as a flux in the finer kinds of glass ; and is now likewise employed in most compositions of the same nature. But this is a noted one by those who are at all acquainted with the principles of the art, so much in the intention of a flux, as in that of a colorific ingredient ; from its power of rendering glass colourless, by destroying the phlogiston in lead, or in any vegetable or animal matter, which may tinge the glass ; as we shall have occasion to observe more particularly in its proper place. As a flux, it is less powerful than fixed alkaline salts of vegetables : and being dearer by much, its use would, therefore, be in proportion less expedient than that of pearl-ashes, if it were to be employed in this view only. The salt-petre that is used here, is brought from the East Indies, in the form of what is called crude nitre ; and in commercial language rough-petre : in which state

it is commixt with some proportion of common salt. It is refined by persons who make it their proper business; and bought for the purposes of glass-making in the state of salt-petre: on which account, it is unnecessary to give the process for refining it here. If it be obtained in crystals of a such a size, that the figure of them may be distinguishable, there is no hazard of any adulteration, but what would be very apparent; as no heterogeneous matter can be made a proper part of such crystals; and, therefore, if they appear bright and colourless, the goodness cannot be doubted.

Sea-salt is also frequently used as a flux in the making glass of various kinds; and it has a very strong power in promoting vitrification even in some obdurate bodies; but, used in a large proportion, it does not produce so strong and tenacious a glass as lead, or even the alkaline salts of vegetables; and is therefore only taken in aid of the others, when admitted as an ingredient. It should be brought to a dry state by decrepitation: that is, keeping it in a moderate heat, till it ceases crackling, before it be put with the other ingredients into the fusing heat: otherwise, by the little explosive bursts of its parts, it will drive some of the powdered matter out of the pot. It must not, after such decrepitation, be again exposed to the air; for, if it be, it will regain its former quality of crackling in a short time.

Borax is the most powerful flux of all the salts, or, indeed, of any known substance whatever: but, on account of its great price, can only be admitted into the composition of glass designed for looking-glass plates, or other purposes, where a considerable value can be set on the produce; or where the quantity wanted is very small. It is brought from the East-Indies, under the name of tincal; and the refinement of it in a perfect manner is hitherto known but to few persons in Europe, who carefully keep it secret. The knowledge of it, however, is not important to the art of making glass; as it is always procured for that purpose in a refined state and not used in very large quantities. The purity of it may be ascertained by the largeness and clearness of

the crystals: for when it is had in that state, it may be always concluded good. The previous preparation of borax for the composition of glass, is to calcine it with a gentle heat, which converts it to a flaky feathery kind of substance like calcined alum: after which it should be ground to powder, and is then fit to be commixt with other ingredients. This calcination of borax should be with a gentle heat, and in a very large vessel proportionably to the quantity; for it swells and rises in inflated bladders, so as to occupy a very great space.

Arsenic is also a powerful flux; but must not be added, nevertheless, in too great quantity. For though when once vitrified perfectly, it greatly promotes the same change in other substances, yet, when added in a redundant proportion, it turns the glass milky or opaque; and keeps it in that state a considerable time before it will duly assimilate; from whence the due vitrification is greatly retarded, so as to occasion an intolerable loss of time and fuel. Though the glass in all such cases would become clear, if continued long enough in the fire, yet, on this principle of its slowness in vitrifying when added to compositions of glass in a large proportion, it is used for giving an opaque white colour to glass as we shall see below.

Wood ashes, by which is to be understood, likewise, those of broom, furze, or any other burned vegetable, are used as a flux for the common bottle or green glass. The ashes must be taken in their original state, consisting of the calcined earth of the vegetable, and their lixivate or fixed alkaline salt; as their virtue lies in their original manner of commixture: for this very extraordinary circumstance attends them, that though in their primitive state they vitrify easily, and act as strong flux to any of the vitrifiable earths or stones; yet, if the salts be separated from the earth, by solution in water, the earth from that time becomes extremely repugnant to vitrification; and though the same salts which were taken away from it, or even a much larger quantity be again added to it, it resists their fluxing power, and displays a nature entirely different from that



which it appeared to have before its separation from the salts. There is no preparation necessary for these ashes, in order to their entering into the composition of glass, except the sifting them to free them from all the fragments of charcoal, or unburned parts of the vegetables employed in their production : but they should be carefully kept from damp and moisture ; which would make the salts deliquiate, and run off from the earth. The goodness of these ashes must be distinguished by their appearing free from impurities, and by their whiteness ; and their abounding in salts, likewise, a proof of their excellence ; which may be examined, by making a *lixivium* of any known small quantity, and judging of its strength by its weight.

*Of the materials used to make glass colourless.*] As the substances used for producing the various colours in glass, will more properly come in question, when I treat particularly of that art, I will omit speaking of them here, and only at present enquire into the nature of nitre and magnesia, which are two ingredients used for rendering the glass colourless, that is intended to be so : and which, indeed, is the kind much the most generally useful, and what makes the only subject of great manufactures.

The general nature of nitre, or salt-petre, has been before observed in speaking of it as a flux ; and it only remains to explain that quality of it, by which it operates in destroying the colour in those compositions of glass, where it is used for that purpose. This quality is, the power of ascending and supporting in a combustible state all bodies, which contain phlogistic and sulphureous matter, if they be brought in contact with it, in a certain degree of heat ; by which means such sulphureous or phlogistic matter is destroyed. Or, in other words, it has the same combustible power with the air in making bodies burn till they be reduced to the state of a calx. In this intention, therefore, salt petre is made an ingredient in those compositions for transparent colourless glass, where lead is used as a flux : for such glass, having, otherwise, a strong tinge of yellow

from the phlogiston of the lead, requires, consequently, the destruction of the phlogiston, at least to a certain degree, in order to its being freed from this tinge. This operation of the nitre on the lead, is most obviously apparent, if a piece of salt-petre be thrown into melted glass formed of lead: for a detonation or explosive effect immediately shows itself: and continues till the acid contained in the salt-petre be consumed.

The distinct knowledge of this principle clearly points out in what compositions of glass, nitre is necessary; and, in some degree, what the proportions may be in which it should be added to each kind: as such proportion must be regulated by the quantity of phlogiston to be destroyed. For, as has been before observed, considered merely as a flux, it is dearer than the pearl ashes, without any advantage, but the being somewhat more void of colour. This is obvious, as it is not only of double the price, but weaker in its action, unless where meeting with phlogistic matter in any of the other ingredients, it be deprived, as was above intimated, of its acid spirit; and converted, as it then will be, to exactly the same kind of fixed alkaline salt, with the pearl-ashes themselves: but in the proportion of only one-third of its original weight. In glass formed of lead, therefore, the use of nitre is absolutely necessary; and, in glass of salts only, where the colour is to be entirely destroyed, and great transparency is wanted, as in the case of looking glass, and several other kinds of plates, it is also requisite in a less proportion. For, tho' the appearance of any slight yellow tinge may be taken away by the use of the magnesia; yet that (for the reason we shall see below) is always attended with a proportionable loss of the transparency.

Magnesia is the other substance employed for rendering glass colourless. It is a scissile, that partakes of the nature of iron ores; but does not contain any considerable quantity of that metal, and sometimes only a very little. It is found in almost every country amongst other iron ores: and frequently, also, above the beds of lead ore; where, indeed, the best seems to have

been always found; probably from its being less replete with iron, than such as is found in the beds of that metal. The hills near Mendip, in Dorsetshire, have particularly afforded extremely good. It is not of any peculiar shape or figure, but somewhat striated like antimony in its texture; and of a brownish black colour like foot. The marks of its being good, is the deepness of the colour, and the being free from specks of a metalline appearance, or a lighter cast: and that should be particularly rejected, which has spots of a reddish brown, or yellowish colour, as being signs of the presence of iron.

When fused with glass of any kind, it readily vitrifies, and tinges the glass of a strong reddish purple colour, but not clear and bright. In consequence of this quality, it is used for destroying any slight yellowish or greenish tinge in glass, that is required to be colourless, on the following principle. The three primitive colours of yellow, red, and blue, when mixed in due proportion, destroy each other; and produce the effect of grey, in the case of opaque bodies; and of black, in such as are transparent. Now the tinge of magnesia in glass being purple, which is a compound of blue and red, and being added to the greenish or yellowish tinge of the glass, consequently destroys the appearance of it; especially the greenish, as the proportion of red in it is greater than that of the blue: but a proportion of black being produced, the glass is obscured in the same degree, though not so as to be perceptible to the eye, without comparing it with some other more pellucid. This is a reason for using the magnesia sparingly, or rather avoiding it entirely, in those compositions of glass, where great transparency is demanded; and for forming them of such ingredients as are most colourless, or may be rendered so by the use of nitre. Magnesia requires to be well calcined in a hot furnace; and then to undergo a thorough levigation: for it ought to be in the state of an impalpable powder, in order to its perfect commixture with the other matter. It was formerly practised to quench the magnesia several times

in vinegar, after reiterated calcinations; with a view of freeing it from any iron that might be mixed with it: but this was needless; and is now entirely disused. Its application to the colouring glass, in which it is very efficacious for many purposes, we shall speak of in its proper place.

*Of the instruments and utensils employed in the composition and preparation of glass.*] The instruments and utensils employed in the compounding and preparing glass are of two kinds: as they are subservient to two different purposes: the levigation and commixture of the ingredient; and the fusion or vitrification of them.

The instruments subservient to levigation, and the mixture of the ingredients, are horse or hand-mills, mortars and pestles, and flat stones and mullars.

The horse, or hand-mills, may be such as are used for other purposes: but the stones should be of a very hard texture, in order that as little as possible of the matter of them may be abraded and commixt with the glass.

Where large mortars are used for such ingredients as are not employed in a sufficient quantity, to make it commodious to grind them in mills, they should be of cast iron, with pestles of the same; and should be carefully kept from rust. But for very nice purposes where the quantity of the matter is small, mortars should be had of bottle or green glass, or of flint or agate, as also a stone and mullar of porphyry or agate, for levigating the calces of metals, or other ingredients used in colouring glass.

Searces or sieves of fine lawn should likewise be provided, for sifting some of the levigated substances. They should be like those of the apothecaries and druggists, with a cover fitted to the upper part; and a box to the under, for preventing that waste of the matter which attends the sifting in the open air.

The utensils employed in the fusing or vitrifying the matter of glass are, furnaces, with the proper iron works; pots for containing the compositions when put into the fire: with the iron instruments for shifting the

matter from one to the other, in case of accident ; and for taking out small portions, to judge of the progress of the vitrification, and the qualities of the glass.

The structure of the furnaces for preparing and working glass in large, is so well and commonly known, that it is needless to enter into the detail of it here. Where smaller quantities are prepared, as in the case of coloured glass, or pastes in imitations of stones, the common wind furnace, or the athanor of the chemists may be used ; or a furnace may be made for this particular purpose, which may be constructed in the following manner :

Mark out a circular area of one yard diameter ; and let a cylindrical building be raised upon it of good stock bricks, and coal-ash mortar, of the height of twelve inches. This cylinder must have an hollow area in the middle, of a round form, twelve inches in diameter ; the rest of the space being filled with solid brick work. But an opening must be left in the front at the bottom, which must be six inches broad and four high, for taking away the ashes ; and it should likewise have an iron frame and door, like those commonly used for feeding the fire in furnaces, that it may be occasionally closed, in order to check or extinguish the fire. This cylindrical fabric being raised to the height of twelve inches, a grate for bearing the fuel, composed of a strong iron ring with bars let into it, must be laid over the round hollow : and another cylinder, of the same diameter and thickness of wall, must be raised in like manner to the height of eight inches above the bars. But this should be done with Windsor bricks, and the mortar formed of Windsor loam, where they can be obtained ; and care should be taken, likewise, that the brick work may have good hold of the rim of the grate. At the height of about five inches above the bars, a frame and door should be fixed for feeding the fire. The door should be about five inches high, and eight long ; and should have a strong latch going across the whole breadth of it, by which it may be opened and shut. When the cylindrical hollow over the bars is thus car-



ried eight inches high, a larger area must be taken of twenty-four inches diameter ; and the brick work must be carried up round it, in the same cylindrical manner as at first, for ten inches more ; except, that four iron doors and frames of the same form with those for feeding the fire must be fixed in the brick work. The dimensions of these doors should be twelve inches high, and eight in breadth ; and the lowest part of them should be level with the flooring made by the brick work on enlarging the area of the cavity of the furnace ; or, in other words, where the brick-work of this wider cylinder begins. These doors should be placed at equal distances from each other, and in such manner, that the other for feeding the fire may be exactly in the middle betwixt the two nearest to the front ; and the chimney betwixt the others. A hole should be likewise left for venting the smoke into the chimney, which may be six inches broad and three high : and after this the brick-work, may be brought together, in the manner of an arch, till the whole cavity be covered. For the whole of this upper part, Windfor bricks and Windfor loom should be used, or, where they cannot be procured, such other as are most like them in their quality of bearing intense heat, without either being calcined or vitrified. The manner of using this furnace is too obvious to require explanation ; it being enough apparent that the flooring in the enlarged cavity is intended for the pots, or crucibles containing the matter ; and the four doors for the more conveniently putting them in and taking them out. When, however, they are to be placed in the furnace, it should not be on the parts before the doors ; for fear the stream of cold air, on opening the doors occasionally, may crack them. But they should be conveyed through one of the doors to the opposite side, by means of an iron peel, formed like those of the bakers ; and put betwixt the doors on that side ; by which means, they will not only be much safer, but will be out of the way of impeding the operator from seeing what passes in every part of the furnace : and, by this means, likewise, room may be found for many more pots and crucibles, than could be

introduced if the first four stood before the doors ; and blocked up the entrance against any other. When this furnace is wanted for calcinations, or other operations that require less heat, the area of the cylinder should be made less by bricks formed of Windsor loom and sand, and adapted to the cylindrical figure of the cavity : which bricks may be easily put in, or taken out, by means of the four doors in the upper part, and that in the lower for feeding the fire. The dimensions of this furnace are calculated to answer the purpose of those, who may engage in these matters for profit ; and may be enlarged, if there be yet occasion : but for such as meddle with them speculatively, and in the view of experiments only, they may be proportionably contracted ; as being much larger than needful.

The pots for containing the melted matter of the glass should be formed of the clay used for making tobacco-pipes, or of the best potter's clay that can be procured. But as there are seldom any such clay found, as will stand the drying and burning well, without the admixture of some earthy body, broken crucibles ground to powder, or, in default of them, white sand, or calcined flints duly levigated, may be added. Near London the tobacco-pipe clay, or the Sturbridge clay, with a fourth or fifth of ground crucibles or sand, are the best materials that can be used : but care should be taken to free the clay perfectly from stones or gravel, and to incorporate the ground crucibles or sand well with the clay. When the tobacco-pipe clay is used, it is previously calcined, and then ground to powder ; and afterwards moistened with water, then well beat in the manner of mortar.

Small pots for making pastes or coloured glasses may be formed on a wooden mould ; and should be slowly dried, and afterwards baked or burned, in a fire very gradually increased to a strong degree, and then suffered to extinguish before the pots be taken out of the furnace. This may be done commodiously in a potter's kiln, along with earthen or stone ware. But the pots should be placed in the hottest part of the furnace. They other-

wife may be burned, where other conveniences are wanting, commodiously enough in the furnace above-mentioned; and if intended to be used in such furnace, the largest may be six inches diameter, and ten or twelve inches in height. However, they must be formed a little conical or narrower at the bottom than the top, that they may be the more easily drawn from the mould; which need only to be a piece of wood turned into the form and dimensions of the cavity of the pot.

*Of the several kinds of white glass; and their composition in general.*] The several kind of white transparent glass now used in most parts of Europe are, the flint-glass (as it is here called) and the German crystal-glass, which are applied to the same uses and purposes;—the glass for plates for mirrors or looking-glasses;—the glass for windows and other lights;—and the glass for phials, and such kind of small vessels.

Of each of these kinds there are several sorts; some only differing in the particular composition and management of the directors of the works where they are manufactured, but alike in their price, and the uses to which they are applied; and others, which are allowedly inferior sorts, sold at cheaper rates, and employed accordingly for coarser purposes.

The several kinds of glass differ in the substances employed as fluxes in forming them, as well as in the coarseness or fineness of such as are used for their body. The flint and crystal, mirror, and best window glass, not only require such purity in the fluxes, as may render it practicable to free the glass perfectly from all colour; but, for the same reason also, either the white Lym-sand, calcined flints, or white pebbles, should be used. The others do not demand the same nicety in the choice of the materials; tho' the second kind of window glass, and the best kind of phial, will not be so clear as they ought, if either too brown sand, or impure salts, be suffered to enter into their composition.

*Of the nature and composition of flint glass; and the German crystal glass.*] Flint glass, is of the same general kind with what is in other places called crystal

glass. It had this name from being originally made with calcined flints, before the use of the white sand was understood ; and, though no flints are now used in its composition, it retains still the name. This kind differs, however, from the German and other crystal glass, in being partly formed of lead ; whereas the fluxing bodies employed for the others, are only salts or arsenic ; and in having a white sand (which as is said before, appears to be fragments of crystal) for its body. Instead of which, calcined flints, or the white river pebbles, or other such stones, are used for the crystal glass in other places : there being no sand of this kind of equal goodness found out of England, as far as is hitherto known.

The composition of flint glass is, therefore principally the white sand and lead ; to which a due proportion of nitre is added, to burn away the phlogiston of the lead : which otherwise imparts a strong yellow tinge to the glass ; and to this is added, for hiding the remainder of the colour, a small quantity of magnesia : as also in some works a proportion of arsenic, to aid the fluxing ingredients. Flint glass is not, however, a simple glass of lead : for where no other salts are added, yet the quantity of nitre used being considerable, and fluxing a proportionable quantity of the sand, it must be considered as a compound glass of salts and lead. But indeed it has been generally practised, to add some quantity of other salts to it ; and diminish proportionably the quantity of lead otherwise necessary. This quantity, though great in the glass made some time ago, seems to be much diminished in that manufactured lately ; at least in some works : as appears from the small weight and transparency of what is now to be met with ; as well as from the vessels being blown much thinner, and of less substance, than the glass in which leads abound could well bear to be. The admission of lead into glass renders such glass less hard and transparent, than that made of salts only. But there is in glass of lead a power of reflecting the rays of light, of the same nature with that of diamonds and topazes, that gives a lustre and brilliant ap-

pearance to vessels of a round figure, not found in the mere glass of salts: where the too great transparency, and want of play, occasions a poorness or deadness in the look, when seen by the other: and this likewise extends itself in some degree to the appearance of liquors contained in them. For polygonal vessels however, or those cut with flat sides, or such as are decorated with flowers, or other ornaments cut in them, or with gilding, the glass of salts is preferable; as may be observed in the instance of those brought from Germany. This must not, nevertheless, be extended to such pieces as are cut with a great number of angles for the parts of chandeliers, or other purposes where the play of the light is wanted: for in all such cases, the glass formed with lead again takes place of the other; as producing a greatly stronger and more beautiful effect, for the reasons before given.

It appears from what has been said, that flint glass may be, as in fact it is, formed of various compositions, by altering the quantities of lead and nitre, and adding equivalent proportions of other salts or arsenic: in consequence of which, savings may be made in the expence, and a difference will arise in the hardness or softness of the glass. For the more the quantities of nitre or other salts are increased, and that of the lead diminished, the more hard and firm the texture of the glass will be; and so vice versa. I will, therefore, give a recipe for the composition of a glass, according to each of the several manners, in which the proportion of the ingredients may be properly varied; and distinguish, likewise, in each case, what the absolute and comparative qualities of the glass produced will be; and with respect to the comparative expence, the quantities of the several ingredients being thus stated, it will be very easy for those who are acquainted with the market-price of them, to make a computation.

No 1. *Composition of the most perfect kind of flint glass.* "Take of the white sand one hundred and twenty pounds, of red lead fifty pounds, of the best pearl-ashes forty pounds, of nitre twenty pounds, and



of magnesia five ounces."—If this composition be fused with a very strong fire, and time be given to it, a glass will be produced, that will have the play of the best flint glass, and yet be hard and strong. It is not so cheap as the compositions below given, where arsenic or common salt is introduced, or where more of the pearl-ashes are used: in either of which cases, savings may be made, by diminishing proportionably the quantities of nitre. But the qualities of this glass will be found to come nearer to the standard of perfection: which is to unite the lustre and hardness together in the greatest degree, they are compatible with each other.

If this composition be, however, desired to flux with less heat and quicker, a powder or two of arsenic may be added: which will be found effectually to answer the purpose.

No. 2. *Composition of flint glass, with a greater proportion of salts.*] "Take of sand one hundred and twenty pounds, of red lead thirty-six pounds, of nitre twelve pounds, and of magnesia six ounces."—This will require much the same fire as the other: but will be harder in its texture; and have less of the refractive play of the light: it is, however, a very good composition of glass; and comes nearer to the kind now made: though I imagine the proportion of lead is still more diminished in some I have seen than here. If it be desired, to be made more yielding to the fire, arsenic may be added as is directed for the preceding; or the quantity of sand may be lessened; but in that case the glass will be softer and weaker.

No. 3. *Cheaper composition of flint glass with arsenic.*] "Take of white sand one hundred and twenty pounds, of the best pearl-ashes thirty-five pounds, of red lead forty pounds, of nitre thirteen pounds, of arsenic six pounds, and of magnesia four ounces."—This glass will require a considerable time in the fire to become clear, and must not, if it can be avoided, be strongly urged at first: for the arsenic is apt to sublime away, if the heat be violent before the other ingredients run into

fusion so as to detain it. It is well, therefore, to mix a considerable proportion of glass, which has been wrought before, and is to be manufactured over again with this composition when it is used; which, running sooner than the new mixed ingredients, will take hold of the arsenic, and fix it. This composition should, however, be afterwards fused, with a considerable heat; and continued in that state till the milky appearance of the arsenic, which it will sometimes retain for a long time, be entirely gone. For notwithstanding this apparent reluctance to perfect vitrification, the arsenic never fails at length to become very transparent glass; and even to contribute greatly to render the other ingredients so likewise. This glass will not be so hard as those of the above compositions: but it will be very clear, and may be employed for the formation of large vessels, where a sufficient thickness can be allowed to give them strength.

No. 4. *Cheaper compositions of glass by means of common salt.*] “Take the proportions of the other ingredients given in the last; and, omitting the arsenic, add in its stead fifteen pounds of common salt.”—This will be more brittle than the last; and therefore cannot be recommended, unless for the fabrication of such kind of vessels, or other pieces, where the strength is of little moment.

No. 5. *Cheapest composition of flint glass, by the addition of arsenic and common salt.*] “Take of the white sand one hundred and twenty pounds, of red lead thirty pounds, of the best pearl-ashes twenty pounds, of nitre ten pounds, of common salt fifteen pounds, and of arsenic six pounds.”—This glass will fuse with a moderate heat; but requires time, like the last, to take off the milky appearance of the arsenic; it is yet softer than the last; and may, therefore, be deemed the worst kind of flint glass that can be made, preserving the appearance of good glass to the eye; which it will have equally with any other when properly managed.

No. 6. *Composition of the best German crystal glass.*] “Take of the calcined flints, or white sand, one hun-

dred and twenty pounds, of the best pearl-ashes seventy pounds, of salt petre ten pounds, of arsenic half a pound, and of magnesia five ounces."—If the pearl-ashes be pure and good, this glass will equal the best of this kind that ever was made. Borax has been frequently used also in the compositions for this sort of glass; but its great price, without any equivalent advantage, will deter from the employing it in large manufactures; as there is no sort of transparent glass in common practice, that of which looking-glass plates is made excepted, can bear the expence of it.

No. 7. *Cheaper composition of German crystal glass* ]  
 "Take of calcined flints, or white sand, one hundred and twenty pounds, of pearl ashes forty-six pounds, of nitre seven pounds, of arsenic six pounds, and of magnesia five ounces."——This composition requires a long continuance of heat, on account of the arsenic, for the reason before given. It produces a glass equally, or more transparent and colourless than the preceding, but somewhat more brittle. The arsenic is, however, so disagreeable an ingredient, from the deleterious qualities of the fumes, which will necessarily rise copiously till the fusion of the other ingredients check it, that, where the advantage is not more considerable than the saving arising from the difference of these two recipes, it is scarcely worth while to submit to the inconveniencies of it.

*Of the nature and composition of the glass proper for plates for mirrors or looking glasses.* ] The glass for forming the looking-glass plates in perfection, is the most nice and difficult kind to manage, of any whatever; there being no latitude, with respect to several of the qualities, as there is in the case of flint glass, without its goodness being really impaired. These qualities are, to be entirely transparent and colourless; to have as little power of refracting the rays of light as possible; to be entirely free from bubbles, specks and flaws, and to be fusible with a moderate heat. Hardness of consistence is of less consequence in this kind of glass than in the flint; though it is an additional excellence; as

far as it may be had along with the other qualities : since the plates may, in that case, be wrought thinner with the same degree of strength, which is a considerable advantage to mirrors made of them.

The white sand is the proper ingredient for forming the body of this kind of glass, as well as of the flint : and the principal part of the flux should be the fixed alkaline salt of vegetables ; which the pearl-ashes will best furnish, when duly purified. This salt must, however, be aided by borax, or common salt ; in order to facilitate the fusion, and prevent the glass from stiffening in that degree of heat, in which it is to be wrought into plates. Lead is by no means a proper ingredient in the composition of this kind of glass ; on account of its augmenting the refracting power ; and for the same reason arsenic, which has the like effect, though in a much less degree should be either omitted, or but sparingly used. The sand should be carefully cleansed for this use, by the means before directed for that purpose, and the borax should be first calcined, and then rubbed to powder. The pearl-ashes must likewise be purified for this use, which may be done in the following way :

*Manner of purifying the pearl-ashes.*] “ Take any quantity of the best pearl-ashes, and dissolve them in four times their weight of water boiling : which operation may be best performed in a pot of cast iron. When they are dissolved, let the solution be put into a clean tub ; and suffered to remain there twenty-four hours or longer. Let the clear part of the fluid be then decanted off from the dregs or sediment, and put back into the iron pot ; in which the water must be evaporated away till the salts be left perfectly dry again. They should then, if not used immediately, be kept in stone jars well secured from moisture and air, till such time as they are wanted.”—Great care should be always taken, in this treatment of the salts, to keep the iron pot thoroughly clean from rust, which would give the yellow tinge to the glass, not to be removed without greatly injuring it.

No. 1. *Best composition of glass for looking-glass plates.*]  
 “Take of white sand cleaned sixty pounds, of purified pearl-ashes twenty five pounds, of salt-petre fifteen pounds, and of borax seven pounds.”—This composition should be continued long in the fire; which should be for some time strong, and afterwards more moderate, that the glass may be entirely free from bubbles before it be worked. It will be entirely clear of all colour, unless in case of some accident: but if any yellow tinge should, nevertheless, unfortunately affect it, there is no remedy, except by adding a small proportion of magnesia, which should be mixed with an equal quantity of arsenic; and after their being put into the glass, giving it a considerable heat again, and then suffering it to free itself from bubbles in a more moderate one, as before. If the tinge be slight, an ounce of magnesia may be first tried; and if that prove insufficient, the quantity must be increased; but the glass will always be obscure, in proportion to the quantity that is admitted; though, perhaps, not in a degree that may prevent it from passing current with those who do not examine with great strictness. This composition is not to be made without expence, at the times when borax is dear; but the great price which looking glass plates, particularly such as are large, bear, will very well allow it: or even the adding a greater quantity of borax, when there is occasion to have the glass run more easily, and roll in a less degree of heat.

No. 2. *Cheaper composition for looking-glass plates.*]  
 “Take of the white sand sixty pounds, of pearl-ashes twenty pounds, of common salt ten pounds, of nitre seven pounds, of arsenic two pounds, and of borax one pound.”—This glass will run with as little heat as the former; but it will be more brittle, and refract the rays of light in a greater degree. It is, therefore, worse than the other in a greater degree, than is balanced by the saving in an article, where the cost of the materials is not considerable in proportion to the return; it being the work and skill, and not the prime expence of the ingredients, that make the high price of looking-glass



plates. It would be, consequently, unpardonable, while they continue to be sold at the present dear rates they bear in this country, to impair the quality of the glass, for the sake of a trifling saving out of the original price of the materials.

*Of the nature and composition of window-glass.]* In order to have window-glass in the utmost perfection, the same qualities and treatment are required, as for the looking-glass plates; and the same kind of glass is, therefore, used for lights, where the expence can be allowed. But as that is only done in extraordinary cases, inferior kinds of various rates of price are wanted for more common purposes; where not only the cost of grinding may be saved, but even the glass itself afforded cheaper, on account of its composition. The best of these kinds is called crown-glass: the composition for which may be as follows; the ingredients being previously prepared in the same manner as for the looking-glass.

No. 1. *Composition of crown (or the best window) glass.]* “Take of white sand sixty pounds, of purified pearl ashes thirty pounds, of salt-petre fifteen pounds, of borax one pound, and of arsenic half a pound.”—This will be very clear and colourless, if the ingredients be good: and will not be very dear. It will run with a moderate heat; but if it be desired to be yet more fusible and soft, half a pound or a pound more of arsenic may be added. If the glass should prove yellow, the magnesia must be used, as above directed for the looking-glass.

No. 2. *Composition for a cheaper kind of window-glass.]* “Take of white sand sixty pounds, of unpurified pearl-ashes twenty-five pounds, of common salt ten pounds, of nitre five pounds, of arsenic two pounds, and of magnesia one ounce and a half.”—This will be inferior to the above kind; but may be improved, where desired, by purifying the pearl-ashes. This operation will not only free them from the remaining part of the earth of the ashes they were extracted from: (which is

apt to give a small degree of opacity to the glass, as it will not vitrify in this state) but renders them also less liable to impart a yellow tinge to the glass; and, therefore, where the goodness of such ashes is known by trial, an ounce of the magnesia, or perhaps more, may be spared.

No. 3. *Composition of common or green window-glass.*]

“Take of white sand sixty pounds, of unpurified pearl-ashes thirty pounds, of common salt ten pounds, of arsenic two pounds, and of magnesia two ounces.”——

This is a cheap composition; and will not appear much green, nor be very deficient in transparency.

No. 4. *Cheapest composition of common or green window-glass.*]

“Take of the cheapest kind of white sand one hundred and twenty pounds, of unpurified pearl-ashes thirty pounds, of wood-ashes well burned and sifted sixty pounds, of common salt twenty pounds, and of arsenic five pounds.”——This composition is very cheap, and will produce a glass with a greenish cast; but greatly superior to what I have frequently met with: though nothing that will at all answer the end, can be well prepared at less expence.

*Of the nature and composition of the glass for phials.*]

The glass of which phials for the use of apothecaries, ink-bottles, and many other such small vessels, are made, is a kind betwixt the flint-glass and the common bottle or green glass. A very good sort of which may be thus prepared:

No. 1. *Composition of the best phial-glass.*]

“Take of white sand one hundred and twenty pounds, of unpurified pearl-ashes fifty pounds, of common salt ten pounds, of arsenic five pounds, and of magnesia five ounces.”——This will be a very good glass for the purpose; and will work with a moderate heat: but requires time to become clear, on account of the proportion of arsenic: when, however, it is once in good condition, it will become very near to the crystal-glass.

No. 2. *Cheapest composition of green or common phial-glass.*]

“Take of the cheapest kind of white sand one hundred and twenty pounds, of wood-ashes well

burned and sifted eighteen pounds, of pearl-ashes twenty pounds, of common salt fifteen pounds, of arsenic one pound." — This will be green, but tolerably transparent; and will work with a moderate fire, and vitrify quickly with a strong one.

*Of the commixture of the ingredients for the several compositions of white transparent glass.*] The commixture of the ingredients for making glass must be performed by different methods, according to the nature of the ingredients that enter into the different compositions.

When sand, and fixed alkaline salts, whether in form of pearl-ashes, or of such as are extracted from them, or any other ashes of vegetables, are used together, they ought to be thoroughly mixed, by grinding them in a place free from damp. When they are so mixed, they should be put into a proper calcining furnace, and there continued in a moderate heat for five or six hours; being in the mean time frequently turned over and stirred about, by means of a proper rake; and at the end of that time taken out of the furnace, and either immediately used, or kept, where no moisture can have access to them, till wanted. The matter in this state is called frit, and may be converted into glass without further preparation, than being broken into gross powder before it be put into the pots; unless where other ingredients are to be added to it: in which case the following methods may be pursued.

When nitre is to be added to the frit, it should be after the calcination: and if it be well powdered, it may be mixed with the frit, without their being ground together.

If arsenic be also used, it should, being previously well levigated, be mixed with the nitre, at the time that it is to be powdered; and they may be then added together to the frit. But if no nitre be used, it should be ground with some pounds of the frit; or rather with some of the salts of which the frit is made; and then put to it.

In the case of the flint-glass, when large proportions of lead and nitre are admitted into the composition ; or in other cases of soft glass, where very powerful fluxes are used ; the calcining the frit is dispensed with, and the sand, alkaline salts, lead, nitre, and also arsenic, if any be used, are thoroughly mixed together by grinding. But if a calcined frit be used, the matter, after it has undergone that operation, and been grossly powdered, must be put into the pot with the other ingredients in that state ; they being previously well commixt together by grinding.

If borax be used with the frit alone, it should be ground with a small part of it ; and then mixed with the rest. But, if other ingredients are to be added, it may be ground with them. It should, however, be always first calcined, that is, placed in a moderate heat, till the ebullition it makes at first be over, and it be left in a dry state.

When common salt is used in the composition of glass where the frit is prepared, it may be added to the alkaline salt and sand when they are to be ground together ; and calcined along with them, which will spare the trouble of the decrepitation, mentioned p. 146 to be necessary. The salt must otherwise be put into a proper vessel, and continued in a gentle heat till it ceases the crackling it will for some time make : and, if it be not used immediately, it must be carefully kept from all moisture, even that of the air. When no frit is previously made, so as to afford an opportunity of calcining the salt with it, being first decrepitated, it may be mixed with any of the other ingredients ; but must not be suffered to attract any moisture ; otherwise it will crackle and decrepitate again in the pots, and waste the matter, by dissipating it with the numberless little explosions it will make.

Magnesia, when admitted into the composition of glass made of frit without any other addition, being well levigated preparatorily, should be intimately mixed by grinding with some pounds of the frit ; and then put into the pots along with the rest. But where lead,

salt-petre, or other ingredients are to be added, it may be mixed with them when they are ground; and then put to the frit. If no frit be prepared, it may, nevertheless, be mingled with any of the fluxing ingredients, and so commixt with the whole mass.

*Of the manner of melting and fusing the several compositions, in order to their conversion into glass: with the means of judging when the vitrification is perfect.]* The materials being all prepared and duly mixed, the matter must be put into the pots: and urged to fusion, by a heat proportioned to the strength of the flux in the composition: and this must be continued till the whole mass become one uniform fluid; and have acquired the qualities necessary in that particular kind of glass which is intended to be produced. There is an attention to another object, however, required in the mean time; which is, the taking off the scum and foulness that will arise on the glass in the action of the ingredients on each other, and the coction of the matter. This is to be done by means of proper ladles; and should be effectually performed before the glass be wrought: otherwise it will be so fouled by this substance, as to be rendered of very little value. This matter is called sandover; and is sold to the colourmen, who dispose of it to the potters; and they use it in the compositions of their glazings.

The exact time for keeping the several compositions of glass in fusion, in order to their perfect vitrification, can by no means be settled by rule. For there is so much variation in the disposition of different parcels of materials of the same kind to vitrify; and likewise so great an uncertainty, with respect to the degrees of heat maintainable even in the same furnace, that it must be left to the judgment of the operator. But where the power of the flux is weaker, as may be gathered from the nature and proportions of the ingredients in the composition, or where the heat is less intense, a greater time will necessarily be required, than in the case of stronger fluxes, and brisker fires. No damage can, however, accrue from allowing a longer fusion than may



be necessary to give the glass the appearance of being perfect, except the loss of time and consumption of fuel: for with respect to the white transparent glass, it is always improved in its hardness and clearness, by a longer coction.

In order to examine, whether the glass have attained to its due state of vitrification, an iron rod, of which the end should be bright, or at least entirely free from rust, must be dipped in the melted matter: and what adheres to it should be first tried, with respect to its ductility or readiness to suffer itself to be drawn out in long threads; and, if this quality be found in it to a sufficient degree, being suffered to cool, it should be carefully inspected, to form a judgment of its colour and clearness. If it be transparent, colourless, and free from all specks and bubbles, it may be concluded perfect, and fit to be wrought. But if it want these marks, more time must be given, according to the degree of the defectiveness; and, after a reasonable allowance of such time, it must be examined again by the same means: and, if not yet perfect, a further time must be given, and then the same trial made again. If, nevertheless, after all reasonable allowance of time, and the application of a strong heat, which should be raised as high as can be admitted conveniently, without detriment to the other operations that may be carrying on in the same furnace, the glass yet appear faulty, the means, below advised, must be called in aid; in order to remedy the defects, either in the materials themselves, or the means of their composition.

*Of the means of promoting and accelerating the perfect vitrification of the ingredients, when the composition proves defective in that point: with the means of removing any yellowish or greenish tinge that may arise.]* If, after the treatment above advised, sufficient time and heat having been given, according to the nature of the composition, the glass will not be brought to run into one equal fluid mass, but appear yet turbid and milky, or to abound in bubbles after some abatement of the fire, it must be concluded, that the flux is too weak. An

additional quantity of the fluxing ingredients, mixed together in the same relative proportion as at first, must be therefore put into the pot to the melted mass; but gradually, lest any sudden ebullition may swell the matter, and force part of it out of the pot. The proportion of the whole of this additional quantity, must be regulated by the appearance of what may be wanted from the backwardness of the vitrification in the glass. But it is better to try a smaller quantity first; because more may easily be added, if found necessary; and an excess, on the other hand, injures the qualities of the glass; and in the case of salts cannot be rectified, unless by a long continuance of the fusion. There is, moreover, this further reason for trying only a smaller quantity at first; that frequently much less will answer the end, than the appearance may seem to make necessary.

It is the practice of some, when the vitrification will not go forwards, to have recourse to the following expedient. They take four, or perhaps six ounces of arsenic, and mix with it an ounce of magnesia: and, wrapping them tightly in a piece of paper of several doubles, they fasten the mass to the end of their iron, and plunge it down to the bottom of the pot; where, the substance of the paper being destroyed, the matter is left. This will frequently succeed; and the glass will grow clear first, towards the bottom, and soon after quite to the top; and gain the perfect state of vitrification. The magnesia, nevertheless, however it may promote the fusing power of the arsenic, does not seem a very proper ingredient in all cases. For where there is no yellow tinge in the glass, it will necessarily impart a purplish cast; which, though perhaps in too slight a degree to be easily distinguished on a common inspection, is nevertheless an imperfection; and would show itself if the glass were to be compared with such as were absolutely colourless. I should think it, therefore, better to join two or three ounces of calcined borax with the arsenic, which would answer the end without any kind of injury to the glass, and would not greatly enhance the expence; when it is premised, how con-

siderable a return a pot of glass makes when worked off.

When the glass appears perfect in other respects, but is found to have a green or yellow tinge, such tinge may frequently be diminished by the addition of one or two pounds of nitre; if none, or but a small proportion, have before been admitted into the composition. The nitre, in this case, should be fluxed with some frit, or with some other glass of the same kind with that in the pot, before it be put to the other ingredients. This is requisite, in order that it may the readier mix with the matter; and not be partly blown out of the pot, by the ebullition it would make, in consequence of the water contained in its crystals, or partly swim on the surface; as would happen, if it were put in crude, without being preparatorily heated or mixed with any other body. But if this fail, or remedy only in part the fault, recourse must be had to the magnesia; to which may be advantageously added two or three ounces of arsenic; and they may be conveyed into the pot by the means above directed; which prevents the powders from floating on the surface of the melted matter, where the arsenic would soon sublime away, and take no effect.

*[Of the composition and treatment of the common bottle, or green glass.]* This kind, excepting the beauty of colour and transparency, is the most perfect glass at present manufactured; and, with respect to its utility, is also equal in importance to any other. It is formed of sand of any kind, fluxed by the ashes of burned wood, or of any parts of vegetables. The ashes must not have the salts extracted from them, but must consist of them, and the calcined earth of the vegetable substances, whence they are produced. This earth, though when once separated from the salts formed along with it in the incineration, it becomes absolutely refractory to vitrification; and resists not only the same salts which were taken from it, but even the strongest fluxes; yet conjoined with these salts, in the manner in which it is originally produced in the incineration, it not only vitrifies perfectly itself, but even acts as a flux on sand.

For on the mixing sand with the entire ashes, a much greater proportion will be converted into glass, than would be by the proportion of salts contained in the ashes, if used alone without the earth. In general, the bottle-glass is only compounded of these two ingredients, sand and wood-ashes: but where the scoria or clinkers of furnaces or forges can be obtained in sufficient quantity, they may be added with great advantage: as a much less proportion of wood-ashes will become necessary, and the good qualities of the glass be rather improved than impaired. The scoria to be obtained at large foundaries, are very proper for the purpose: or those from any other such works, where large and strong fires are used. The particular composition of this glass may be as follows; but the proportions here given suppose the softest sand: to procure which care should be taken, as a great saving is thence made in the quantity of wood-ashes necessary.

*Composition of green or bottle-glass.*] “Take of wood-ashes two hundred pounds, and of sand one hundred pounds. Mix them thoroughly well by grinding together.”—This is the due proportion where the sand is good, and the wood-ashes are used without any other addition: but there are instances of sand of so kindly a nature for vitrification, that a greater proportion of it may be added.

*Composition of green or bottle-glass, with the addition of scoria or clinkers.*] “Take of wood-ashes one hundred and seventy pounds, of sand one hundred pounds, and of scoria or clinkers fifty pounds. Mix the whole well by grinding them together.”—The clinkers should be well ground before they be used, if they admit of it. But frequently they are too hard; and in that case they should be broken into as small bits as can be done conveniently; and mixed with the other matter without any grinding. The harder they are, the less material will be the powdering them, as they will the sooner melt of themselves in the furnace; and, consequently, mix with the other ingredients.

The general manner of fusing, and converting this

composition to glass, is the same as in the other kinds : as are also the means of judging when the vitrification is perfect ; and the remedy of the defect when the first composition will not produce it ; except with respect to colour, which is, in the case of this kind of glass, entirely out of question. When clinkers are not to be had in sufficient quantity, to allow of their being used in the general composition, it is well however to have some quantity, to employ occasionally, when the vitrification fails. For the adding such a proportion of them as may appear necessary, with an equal part of wood-ashes, will answer the purpose much better, than the addition of more wood-ashes alone, where the flux is found too weak ; as will happen sometimes from the great variation in the different parcels, as well of the ashes as sand.

*Of the general nature of coloured glass : and of the several compositions proper for receiving the colours, in order to the forming glass, or paste, in imitation of precious stones ; with the qualities attendant on each.* ] The glass, which is intentionally tinged with colours, may be divided into three kinds : the white opaque and semi-transparent glass : the transparent coloured glass : and the semi-transparent or opaque coloured glass.

The white opaque glass, as also some transparent kinds, are principally used for making small vases, toys, and some sorts of useful vessels, as cream-pots, &c. in imitation of China-ware of any kind, of which we shall speak below. It is also frequently employed, as a white enamel for grounds, by painters of enamel dial-plates, snuff-boxes, and other such pieces, as have not occasion to pass several times through the fire, in order to their being finished.

The composition of white opaque and semi-transparent glass is very various ; as any kind of coloured glass may be made the body of such ; and the tinge may be given by calcined tin or antimony ; also by arsenic, calcined hartshorn or bones, and several other substances.

The transparent glass, tinged with colours, is likewise of different kinds, as the body or ground may be



transparent colourless glass, or any of the compositions above exhibited. But it is commonly distinguished into two sorts only; the one called coloured glass, and the other pastes. The reason of which distinction lies in this. The chief design of all coloured transparent glass being the imitation of precious stones, the qualities of such glass, when perfect, are to be very clear and transparent; to be free from all colour but the proper tinge; and to be very hard and tenacious in their texture. But these qualities being not to be had, except in glass that is very difficult to be melted, and requires a long as well as an intense heat, both to its own mature vitrification, and that of the bodies added to give the colour to it; it became inconvenient to those who prepared these kind of compositions in small quantities, to maintain such strong fires; and therefore softer compositions were sought for, that would run with the heat of common small furnaces; and would likewise be brought to perfection in a much shorter time. These compositions were therefore called pastes, to distinguish them from the harder glass, which retained its proper appellation.

The glass most proper for the imitation of precious stones, where the hardness, which is a most valuable quality in such as is intended for mock jewels, that are exposed to much wear, is wanted, is a perfect glass of salts; in which no more flux is admitted, than merely what may be necessary for the complete vitrification of the glass, and tinging substances; but it should be absolutely free from every kind of tinge, except that which is intended to be given it.

The kind most proper for forming pastes, is a mixed glass of lead and salts, which will run easily; and vitrify in a short time the metalline or other bodies that are employed for tinging it. But in order to make it yet more fusible, without having so large a proportion of lead as may make the texture of the glass too tender and brittle, arsenic and borax may be admitted into the composition. Besides the forming imitations of coloured

stones, there is yet another purpose to which this kind of glass is peculiarly adapted, which is the making mock diamonds and topazes, that cannot be so well counterfeited by any other composition; as the lead, according to what was before observed, gives a very extraordinary refracting power to the glass, of which it is an ingredient. This sort might seem to belong to the class of the white transparent kinds of glass before treated of: but as the application of that kind of composition, which renders it properly a paste according to the above distinction, is confined to the intentions of imitating gems, it is more properly introduced amongst the others, with which it has a common denomination.

The semi-transparent coloured glass may have for its body, either the compositions of the harder kinds; or those of pastes: and it is principally applied to the imitation of the semi-transparent stones, as lapis lazuli, chalcedony, jasper, agate, opal, or such others. The manner of composing them is much the same, as that of the transparent kinds; except the adding some opaque white body, which will endure the fusion of the glass, without being vitrified, at least long enough to suffer it to be worked into the proper form. But the management of those of this kind, which are compounded of a variety of colours, is much more difficult than that of the transparent sorts: which is most probably the reason why they are so little in use; though some of them have a very beautiful effect for purposes they might be equally well applied to with the genuine stones.

*Of the nature and preparation of the substances used for tinging glass.]* The substances employed for tinging glass, are, for the most part, metallic and other fassible bodies; or indeed all are so, except tartar, which has been added to some compositions. The metals themselves make the principal part; and, properly treated, will produce all the colours, except a perfect blue. But for cheapness and expedience, the semi-metals, and preparations from other fassible bodies, are sometimes admitted into the place of them; particularly with re-

spect to yellow, where antimony supplies the place of silver.

The substances that have been used for producing any opaque whiteness in glass, are calcined tin, (commonly called putty) calcined antimony, arsenic, calcined horns or bones, and sometimes common salt. The substances employed for red, are gold, iron, copper, magnesia and antimony. The substances employed for blue, are zaffer and copper. The substances that have been employed for yellow, are silver, iron, antimony and magnesia, with tartar. The substances employed for greens, are copper, Bohemian granate, and those which will produce yellow or blue. The substances employed for purple, are all such as will produce red and blue. The substances employed for orange colour, are antimony, and all those which will produce red and yellow. The substances employed for black, are zaffer, magnesia, copper and iron, in various combinations. The Bohemian granate requires no other preparation than to be well pulverized.

*Composition of hard glass and pastes, proper for receiving colours.*] Though almost every kind of transparent colourless glass will admit of being tinged; yet there are, as was observed before, some compositions, that are more peculiarly adapted to the purposes for which the coloured glass is intended, either by their hardness and tenacious texture; or their being more easy to be wrought by those who manufacture them, from their requiring less heat to fuse them, and fluxing the colorific matter expeditiously. The clearness and transparency of the glass, and the being devoid of any colour but that intended to be given, are likewise necessary in both the hard glass and pastes which are to be coloured: and therefore to have them in perfection, a glass of each kind should be purposely prepared; in which more exact methods may be used for producing these qualities, than are expediently compatible with the dispatch and profit of grosser manufactures. The best compositions for the hard glass are as follows: but as the extreme purity of the fixed alkaline salts is of very

great consequence in this case, it may not be improper to give previously the method of producing it.

*Method of bringing pearl-ashes, or any other fixed alkaline salts of vegetables, to the highest degree of purity, proper for the most transparent glass.]* “Take of the best pearl-ashes three pounds, and of salt-petre six ounces. Pound them together in a glass or marble mortar, till they are thoroughly well mixed; and then put part of them into a large crucible, and set it in a furnace, where it may undergo a strong heat. When the part of the matter, that was first put into the crucible, is heated red hot, throw in the rest gradually: and if the crucible will not contain the whole, pour part of the melted matter out on a moistened stone, or marble; and, having made room in the crucible, put in the rest; and let it continue there, likewise, till it be red hot. Pour it out then as the other; and afterwards put the whole into an earthen, or very clean iron pot, with ten pints of water; and heat it over the fire, till the salts be entirely melted. Let it then, being taken off the fire, stand till it be cold; and afterwards filter it through paper, in a pewter cullender. When it is filtered, return the fluid again into the pot, and evaporate the salt to dryness, which will then be as white as snow; the nitre having burnt all the phlogistic matter that remained in the pearl-ashes after their former calcination.

No. 1. *Composition of the best and hardest glass for receiving colours.]* “Take of the best sand, cleansed by washing as directed in p. 147, twelve pounds, of pearl ashes, or fixed alkaline salt purified with nitre as above, seven pounds, of salt petre one pound, and of borax half a pound.”—The sand being first reduced to powder in a glass or flint mortar, the other ingredients should be put to it, and the whole well mixed, by pounding them together.

No. 2. *Composition of the best glass for receiving colours; but somewhat less hard than the above.]* “Take of white sand cleansed twelve pounds, of pearl-ashes purified with salt-petre seven pounds, of nitre one pound, of borax half a pound, and of arsenic four ounces.”—

Proceed as in the last ; but if the glass be desired to melt with yet less heat, a pound of borax may be used instead of the half pound, and a pound of common salt may be added ; but this last is apt to make the glass more brittle ; which is an injury done to such as is to be cut into very small pieces, and ground with so many angles in the figure, as in the imitations of jewels.

No. 3. *Composition of soft glass or paste, proper for receiving colours.*] “ Take of white sand cleansed six pounds, of red-lead three pounds, of purified pearl-ashes two pounds, and of nitre one pound.”—Proceed in the mixture as with the foregoing.

No. 4. *Composition of glass, or paste, much softer than the above.*] “ Take of white sand cleansed six pounds, of red lead and purified pearl-ashes, each three pounds, of nitre one pound, of borax half a pound, and of arsenic three ounces.”—To be mixed as all the preceding. This is very soft, and will fuse with a very gentle heat, but requires some time to become clear, on account of the arsenic. It may even be prepared and tinged in a common fire without a furnace ; if the pots containing it can be surrounded by burning coals, without danger of their falling into it. The borax, being a more expensive ingredient than the others, may be omitted, where a somewhat greater heat can be applied ; and the glass is not intended for very nice purposes. Or a pound of common salt may be substituted in its place. But the glass will be more clear and perfect ; and free itself much sooner from bubbles, where the borax is used. This glass will be very soft, and will not bear much wear, if employed for rings, buckles, or such imitations of stones, as are exposed to much rubbing. But for ear-rings, ornaments worn on the breast, or such others as are but seldom put on, it may last a considerable time. In all these soft compositions, care should be taken, that part of the sand be not left unvitified in the bottom of the pot ; as will sometimes happen. For, in that case, the glass, abounding too much with salts and lead, will not bear the air ; but being corroded by it, will soon contract a mistiness, and



specks on the surface ; which will entirely efface all the lustre of the paste. An unlucky instance of this particularly happened a few years ago, to the great loss, and almost ruin of many of the poorer lapidaries. For there being at that time a great demand for all kinds of ornaments decorated with false stones for the Spanish West-Indian trade, a person undertook to make them and furnish the lapidaries ; who, glad of an opportunity of obtaining, on moderate terms, what they had found it difficult to procure before, (as the coloured glass had for the most part been imported from Venice) purchased as large quantities as they possibly could find money to pay for. But in a short time, both the unwrought paste, and that which they had been at the labour and expence of cutting, all turned foul, with a dull scum on the surface and little specks, which eat down into the substance ; and took away the smoothness, as well as the lustre. It is proper, therefore, for those, who prepare such compositions, to be careful of adding more salts and lead than the proportions here given ; and to watch that the sand, or other matter employed for the body of the composition, be really fluxed. And it is equally proper, that they who purchase such paste, should have some good ground of assurance of its being duly prepared ; otherwise, they may throw away their money in the purchase, their time in cutting, and their credit in disposing, of such a faulty commodity. There is a very certain and good method of preventing the inconvenience arising from the separation of the salts in the preparation, as well of the hard kind of coloured glass, as the pastes ; which is, by previously calcining the sand, and fixed alkaline salts, as in the manner of making the frit. This may be done, by putting the sand and salt, reduced to powder and mixed together, on a tile placed in a furnace of moderate heat ; and turning over and stirring the matter with a tobacco-pipe, or small iron rod ; for which purpose, the tile should be either placed near some proper opening into the furnace, or drawn to the door at due intervals. When the matter appears to coalesce strongly, and form a hard body on cooling, it may be taken out ; and being kept entirely free from

moisture, should be powdered. It should be then added to the other materials according to the proportion that would have been observed, with regard to the ingredients of the frit, if they had been used without being combined previously, by means of this operation.

*Compositions of glass, or paste, of a red colour.*

No. 1. *Composition of a fine red glass resembling the ruby.*] “Take of the hard glass, No. 1. or No. 2. one pound, of the calx cassii, or gold prepared by precipitation, with tin 3 drachms. Powder the glass; and grind the calx or gold afterwards with it in a glass, flint, or agate mortar; and then fuse them together.”

—This may be made of a stronger or more diluted colour, by varying the proportion of the gold: in adjusting which properly, regard should be had to the application of the glass, when made. For where this glass is set in rings, bracelets, or other close work, where foils can be used, a great saving may be made, with regard to the colour of it, without much injury to the effect. But for ear-rings, or other purposes, where the work is set transparent, a full strong colour should be given: which may be effected by the proportions directed in this composition.

No. 2. *Composition of a paste resembling the ruby.*] “Take of the paste, No. 3. or No. 4. one pound, of calx cassii, or precipitation of gold by tin, two drachms. Proceed in the mixture as with the above.”—This will be equally beautiful with the above; and defective only in softness. But as that greatly takes away the value for some purposes, such as is appropriated to them may be tinged in a cheaper manner by the following means.

No. 3. *Composition of a cheaper paste resembling the ruby.*] “Take of the composition for paste, No. 3. or No. 4. half a pound, of glass of antimony half a pound, and of the precipitation of gold by tin one drachm and half. Proceed as with the others.”—This will be considerably cheaper; and will have much the same effect, except that it recedes more from the crimson to the orange.

No. 4. *Composition for hard glass resembling the garnet.*] “Take of the compositions for hard glass, No. 1. or No. 2. two pounds, of glass of antimony one pound, of magnesia, and of the precipitate of gold by tin, each one drachm”—This composition is very beautiful, but too expensive, on account of the gold, for the imitation of garnets for common purposes, on which account the following may be substituted.

No. 5. *Cheaper composition of hard glass resembling the garnet.*] “Take of the compositions, No. 1. or No. 2. two pounds, of the glass of antimony two pounds, and of magnesia, two drachms.”—If the colour be found too dark and purple in either this and the preceding composition, the proportion of magnesia must be diminished.

No. 6. *Composition of paste of the colour of garnet.*] “Take of the compositions for pastes, No. 1. or No. 2. and proceed as with the above.”

No. 7. *Composition of hard glass resembling the vinegar garnet.*] “Take of the compositions No. 1. or No. 2. two pounds, of glass of antimony one pound, of iron highly calcined half an ounce. Mix the iron with the uncoloured glass, and fuse them together, till the mass be perfectly transparent; then add the glass of antimony powdered, stirring the mixture with the end of a tobacco-pipe; and continue them in the heat, till the whole be perfectly incorporated.”

No. 8. *Composition of paste resembling the vinegar garnet.*] “Take of the composition for paste, No. 3. or No. 4, and proceed as with the foregoing.”—In this, as well as in all the succeeding compositions, it should be observed, that some allowance may be made in the proportion of the colorific, or tinging matter, for the greater variety of the pastes than the hard glass, on the score of the lead which enters into the composition. For, as the volume, in a pound weight of the paste, is, consequently, less; a less quantity of tinging matter is proportionably necessary to give the same force of colour to it.

*Compositions of glass and paste, of a blue colour.*

No. 1. *Composition of hard glass of a very full blue colour.*] “Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of zaffer six drachms, and of magnesia two drachms. Proceed as with the above.”—If this glass be of too deep a colour, the proportions of the zaffer and magnesia to the glass may be diminished: and if it verge too much on the purple, to which cast it will incline, the magnesia should be omitted. If a very cool or pure blue be wanted, instead of the magnesia, half an ounce of calcined copper may be used; and the proportion of zaffer diminished by one half.

No. 2. *Composition of paste of a full blue colour.*] “Take of the composition for paste, No. 1. or No. 2. ten pounds, and proceed as with the foregoing.”

No. 3. *Composition of hard glass resembling the sapphire.*] “Take of the compositions for hard glass, No. 1. or No. 2. ten pounds, of zaffer three drachms and one scruple, of the calx cassii, or precipitation of gold by tin, one drachm. Proceed as with the above.”

No. 4. *Cheaper composition of hard glass resembling the sapphire.*] “As the foregoing; only, instead of the precipitate of gold, use two drachms and two scruples of magnesia.”—If this be well managed, the colour will be very good; and the glass, when set and cut, will not be easily distinguishable from the true sapphire: but the preceding will be a fine colour, as there is a foulness in the tinge of the magnesia, which will always diminish, in some degree, the effect of brighter colours, when mixed with them.

No. 5. *Composition of paste resembling the sapphire.*] “Take of the composition for paste, No. 3. or No. 4. and proceed as with the foregoing.”—It is not worth while to bestow the expence of colouring pastes with the gold; and it is, therefore, more expedient, in the case of such, to use the other method.

No. 6. *Composition of hard glass and paste, resembling sapphires, by means of smalt.*] “Take of the compositions for hard glass and pastes, any quantity; and

mix with them one-eighth of their weight of smalt, the brightest and most inclining to purple, that can be procured."—If it be desired to give a more purple tinge, magnesia may be added in the proportion required.

No. 7. *Composition of hard glass resembling the eagle marine (vulgarly called egg-marine.)* "Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of copper highly calcined with sulphur three ounces, and of zaffer one scruple. Proceed as with the foregoing."

No. 8. *Composition of paste resembling the eagle marine.* "Take of the composition for paste, No. 1. or No. 2. ten pounds; and proceed as with the above." *Compositions of hard glass, and pastes, of a yellow colour.*

No. 1. *Composition of hard glass of gold, or full yellow colour.* "Take of the compositions for hard glass, No. 1. or No. 2. ten pounds, but omit the salt-petre; and for every pound add an ounce of calcined borax; or, if that do not render the glass sufficiently fusible, two ounces, of red tartar, the deepest coloured that can be procured, ten ounces; of magnesia two ounces; of charcoal of fallow, or any other soft kind, two drachms. Proceed as with the rest."—This colour may be prepared with silver: but as there is no advantage in that to counterbalance the expence, I wave giving the process.

No. 2. *Composition of paste of a gold or full yellow colour.* "Take of the composition for paste, No. 3. or No. 4. prepared without the salt petre, ten pounds; of iron strongly calcined, one ounce and a half. Proceed as with the others."—The crude tartar and the charcoal must not be used, where lead enters into the composition of the glass; and the nitre may be spared; because the yellow tinge given to the glass by the lead, on account of which the nitre is used, is no detriment in this case; but only adds to the proper colour. This colour may also be prepared by crude antimony, as well as the calcined iron: but it is more difficult to be managed, and not superior in its effect.



No. 3. *Composition of hard glass resembling the topaz.*] “ Take of the composition for hard glass, No. 1. or No. 2. ten pounds, and an equal quantity of the gold coloured hard glass. Powder, and fuse them together.”—As there is a great variety in the colour of the topaz, some being a deeper yellow, and others slightly tinged, the proportions of the yellow glass to the white, may be accordingly varied at pleasure: that here given being for the deepest.

No. 4. *Composition of paste resembling the topaz.*] “ This may be done in the same manner as the preceding: but the salt-petre may be omitted in the original composition of the glass: and for the resemblance of the very slightly coloured topazes, neither the gold coloured paste, nor any other tinging matter need be added, that of the lead being sufficient, when not destroyed by the nitre.”

No. 5. *Composition of hard glass resembling the crysolite.*] “ Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of calcined iron six drachms. Proceed as with the above.”

No. 6. *Composition of paste resembling the crysolite.*] “ Take of the composition for paste, No. 3. or No. 4. prepared without salt-petre, ten pounds, and of calcined iron five drachms. Proceed as with the rest.”

*Composition of hard glass, and paste, of a green colour.*

No. 1. *Composition of hard glass resembling the emerald.*] “ Take of the composition for hard glass, No. 1. or No. 2. nine pounds, of copper, precipitated from aquafortis, three ounces, and of precipitated iron two drachms.”

No. 2. *Composition of paste resembling the emerald.*] “ Take of the composition for paste, No. 1. or No. 2. and proceed as with the above: but if the salt-petre be omitted in the preparation of the paste, a less proportion of the iron will serve.”

*Compositions of glass and pastes, of a purple colour.*

No. 1. *Composition of hard glass, of a deep and very bright purple colour.*] “ Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of zaffer six

drachms, of gold precipitated by tin one drachm. Proceed as with the rest."

No. 2. *Cheaper composition of hard glass of a deep purple colour.*] "Take of the compositions for hard glass, No. 1. or No. 2. ten pounds, of magnesia one ounce, and of zaffer half an ounce. Proceed as with the others."

No. 3. *Composition of paste of a deep purple colour.*] "Take of the compositions for pastes, No. 3. or No. 4. ten pounds; and treat them as the foregoing."

No. 4. *Composition of hard glass of the colour of the amethyst.*] "Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of magnesia one ounce and a half; and of zaffer one drachm. Proceed as with the rest."

No. 5. *Composition of paste of the colour of the amethyst.*] "Take of the composition for paste, No. 1. or No. 2. ten pounds; and treat it as the preceding."

*Of paste resembling the diamond.*] "Take of the white sand six pounds, of red-lead four pounds, of pearl-ashes, purified as above directed, three pounds, of nitre two pounds, of arsenic five ounces, and of magnesia one scruple. Proceed as with the others: but continue the fusion for a considerable time, on account of the large proportion of arsenic."—If this composition be thoroughly vitrified, and kept free from bubbles, it will be very white, and have a very great lustre; but, if on examination it yet appear to incline to yellow, another scruple or more of the magnesia may be added. It may be rendered harder, by diminishing the proportion of lead, and increasing that of the salts; or fusing it with a very strong fire: but the diminution of the proportion of lead will make it have less of the lustre of the diamonds.

*Composition of hard glass perfectly black.*]—"Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of zaffer one ounce, of magnesia, and of iron strongly calcined, each six drachms. Proceed as with the rest."

*Composition of paste perfectly black.*] "Take of the

composition for paste, No. 1. or No. 2. prepared with the salt petre, ten pounds, of zaffer one ounce, of magnesia six drachms, and of iron highly calcined five drachms. Proceed as with the others."

*Of the white opake, and semi-transparent glass, and pastes.*

No. 1. *Composition of white opake glass.*] "Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of horn, ivory or bone, calcined perfectly white, one pound. Proceed as with the others."

No. 2. *Composition of paste of an opake whiteness.*] "Take of the composition, No. 3. or No. 4. ten pounds, and make the same addition as to the above."

No. 3. *Composition of glass of an opake whiteness formed by arsenic.*] "Take of flint-glass ten pounds, and of very white arsenic one pound. Powder and mix them thoroughly, by grinding them together; and then fuse them with a moderate heat, till they be well incorporated: but avoid liquifying them more, than to make a perfect union."—This glass has been made at a considerable work near London in great quantities; and has not only been manufactured into a variety of different kinds of vessels, but, being very white and fusible with a moderate heat, has been much used as a white ground for enamel in dial-plates, snuff-boxes, and other pieces, which have not occasion to go several times into the fire to be finished. It will not, however, bear repeated burnings, nor a strong heat continued for any length of time, when applied to this purpose, without becoming transparent; to which likewise, the smoke of a coal fire will also greatly contribute: but it answers the end very well in many cases; though even in those, enamel of the same degree of whiteness would be preferable; as this is always brittle, and of less firm and tenacious texture.

No. 4. *Composition of hard glass, or paste, formed by calk of tin or antimony.*] "Take of any of the compositions for hard glass or pastes, ten pounds, of calcined tin, (commonly called putty) or of antimony, or tin calcined by means of nitre, one pound and a half. Mix them well, by grinding them together; and then fuse

them with a moderate heat.”—The glass of this kind, made with the composition for pastes, differs in nothing from white enamel, but in the proportion of the calx of tin and antimony : and, if those calxes be prepared with nitre, (without which they cannot be made to produce a pure whiteness in glass) this composition will be more expence and trouble than those above given, without any other advantage, than that it will bear the action of a much stronger and longer continued fire, without losing its opacity in any degree, than the others.

No. 5. *Composition of semi-transparent white glass and paste, resembling the opal.*] “Take of any of the compositions for hard glass, or paste, ten pounds, of horn, bone, or ivory, calcined to a perfect whiteness, half a pound. Proceed as with the rest.”—This white hard glass is much the same with the German glass formerly brought here in porringers, cream-pots, vinegar-cruets, and other such pieces, of which we frequently meet with the remains.

*Compositions of fictitious or counterfeit lapis lazuli.*] “Take of any of the above compositions for hard glass, or paste, ten pounds, of calcined bones, horn or ivory, three quarters of a pound, of zaffer one ounce and a half, of magnesia half an ounce. Fuse the uncoloured composition with the zaffer and magnesia, till a very deep transparent blue glass be produced. The mass being cold, powder it : and mix it with the calcined matter, by grinding them together. After which, fuse them with a moderate heat, till they appear to be thoroughly incorporated ; and then form the melted mass into cakes, by pouring it on a clean bright plate of copper or iron.”—If it be desired to have it veined with gold, it may be done, by mixing the gold powder with an equal weight of calcined borax, and tempering them with oil of spike ; by which mixture, the cakes, being painted with such veins as are desired, they must be put into a furnace of a moderate heat ; and the gold will be cemented to the glass, as firmly as if the veins had been natural. If the counterfeit lapis lazuli be

desired of a lighter hue, the quantity of zaffer and magnesia must be diminished; or, if it be required to be more transparent, that of the calcined horn, bone, or ivory, should be lessened. Instead of zaffer, where that cannot be obtained, a proper proportion of smalt may be substituted. And in all cases, indeed, it may be a more certain way, to form the zaffer and vitrifying ingredients into glass alone, and then, having powdered them with the calcined bones or horns, infuse them a second time, and make them into cakes in the manner directed. For the fluxing power of the ingredients of the glass is so retarded by the calcined bone or horn, that it may, in some cases, fail to act sufficiently on the zaffer to vitrify it perfectly.

*Composition of hard glass resembling the red cornelian.]*

“Take of the compositions for hard glass, No. 1. or No. 2. two pounds, of glass of antimony one pound, of the calcined vitriol, called scarlet oker, two ounces, and of magnesia one drachm. Fuse the glass of antimony and magnesia with the other glass first together; and then powder them well, and mix them with the scarlet oker, by grinding them together; and afterwards fuse the mixture with a gentle heat, till they be incorporated: but the heat must not be continued longer than is absolutely required to form them into a vitreous mass.”—If it be desired to have the composition more transparent, a proportionable part of the red oker must be omitted.

*Composition of paste resembling the red cornelian.]*

“Take of the compositions for pastes, No. 1. or No. 2. two pounds; and proceed as with the above.”

*Composition of hard glass resembling the white cornelian.]*

“Take of the compositions for hard glass, No. 1. or No. 2. two pounds, of yellow oker well washed, two drachms, and of calcined bones, each one ounce. Mix them well by grinding them together; and fuse them with a gentle heat, till the several ingredients be well incorporated in a vitreous mass.”

*Composition of paste resembling the white cornelian.]*



“Take of the composition for pastes, No. 1. or No. 2. two pounds ; and proceed as with the foregoing.”

*Composition of hard glass, or paste, resembling the turquoise stone.*] “Take of the composition for blue glass, or paste, No. 7. or 8. (being those resembling the eagle-marine) ten pounds, of calcined bone, horn, or ivory, half a pound. Powder and mix them well ; and then fuse them in a moderate heat, till they be thoroughly incorporated.”——If the colour be not so deep as may be desired, a small proportion of smalt may be added.

*Composition of the brown Venetian glass with gold spangles ; commonly called the Philosopher's stone.*] “Take of the composition for hard glass, No. 2. and the composition for paste, No. 1. each five pounds, and of highly calcined iron one ounce. Mix them well, and fuse them till the iron be perfectly vitrified ; and have tinged the glass of a deep transparent yellow brown colour. Powder this glass ; and add to it two pounds of glass of antimony, being powdered ; and mix them well, by grinding them together. Take part of this mixture, and rub into it fourscore or one hundred leaves of the counterfeit leaf-gold, commonly called Dutch gold ; and, when the parts of the gold seem sufficiently divided, mix the powder containing it with the other part of the glass. Fuse the whole then with a moderate heat, till the powder run into a vitreous mass fit to be wrought into any of the figures, or vessels, into which it is usually formed : but avoid a perfect liquefaction ; because that destroys, in a short time, the equal diffusion of the spangles ; and vitrifies, at least part, the matter of which they are composed ; converting the whole to a kind of transparent olive-coloured glass.”——This kind of glass is used for a great variety of toys and ornaments, and procured from the Venetians. A few years ago a very great demand arose for it to China, and raised the price very high, till such quantities had been brought from Venice, and sent thither, as glutted the market. But there is no reason why it should not be equally well prepared here ; and

at a small expence ; as will be found, on a few trials, by those who will carefully execute what is here directed.

*Of the fusion and vitrification of the several compositions of coloured glass ; with the particular rules and cautions to be observed in the management of each kind.*] The several compositions above-mentioned being prepared according to the directions respectively given ; the matter should be put into proper pots, of which it should not fill above two-thirds ; and then placed in the furnace, or in any other kind, where they may receive a sufficient heat, and be secured from any coals, soot, or any other filth, falling into them. In order to prevent which, it is expedient, with regard to the pots in which this kind of glass is prepared, to have covers over the tops of them, with a little return over the side. And it is also proper to have a hole in the side, a little below the return ; through which an iron may be passed to take out a small quantity of the melted matter, for the judging of the progress of the vitrification. These pots, when put into the furnace above-mentioned, should be placed on the flooring or stage intended to support them in the part betwixt the doors, opposite to that through which they are passed into the furnace, according to the manner before directed ; which should be done by means of a strong iron peel, like those used by the bakers. It is necessary to observe, likewise, that however well the pots may have been before baked, it is always proper, in the case of glass of greater value, where the clearness and beauty is of consequence, to give them another burning before they be used ; and, at the same time, to incrust them over with any common colourless glass ; which may be done in this manner : Having reduced the glass to powder, moisten all the inside of the pot with water ; and, while it is yet moist, put in some of the powdered glass, and shake it about till the whole inner surface of the pot be covered by what will adhere to it, in consequence of the moisture. Throw out then the redundant part of the powdered glass ; and, the pot being dry, set it in a furnace sufficiently

hot to vitrify the glass adhering to it ; and let it continue there some time : after which, care must be taken to let it cool gradually.

The pots, containing the composition, being thus placed in the furnace, a gentle heat, such as will just keep the pots red hot, should be given for the first hour or longer. There is, however, an exception to this, which is, where there is much arsenic in the composition, which requires that some degree of vitrification should be brought on as quickly as possible, in order to fix it, and prevent its subliming away from the other ingredients ; which it will not cease to do, so long as continued in the state of a powder. But where a gentle heat is proper at first, after the expiration of an hour and a half, or two hours at furthest, the heat may be raised sufficiently to produce a vitrification ; but not so as to render the melted matter very fluid at first ; which in this part of the process would occasion a separation of the ingredients ; and greatly retard, if not intirely prevent, the perfect vitriolic incorporation of the whole.

The due degree or continuance of heat, for the perfecting these kinds of glass, cannot be settled by any standard, as they are varied both by the nature of the composition, and the quantity of the matter. But in the case of pots which hold ten or eleven pounds, twenty or twenty-four hours may be allowed for hard glass, and fourteen or sixteen for pastes. And where much arsenic enters into the composition, though it is necessary to bring on a quicker vitrification, yet more time must sometimes be given to the matter, than in other cases, before all the cloudiness be dissipated.

In the fusion of the transparent coloured glass, it is above all things necessary to avoid stirring the matter, or even shaking the pots ; as it would otherwise hazard the causing bubbles in the glass, to prevent which is the greatest difficulty attending the preparation of counterfeit gems. But if the ingredients, by their action on each other, do yet, notwithstanding all exterior concussion be avoided, produce bubbles, the glass must be continued in fusion till they wholly vanish. And

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if, when bubbles do arise in the glass, and time be given for it, there appear no tendency to their going away, the heat must be gradually raised to a greater pitch, that the glass may be rendered more fluid, and that viscosity, which was the occasion of their detention, removed.

When a proper time has been given the glass to attain to a perfect state of vitrification, it should be examined, by putting the small end of a tobacco-pipe to the surface of the glass, thro' the hole in the side of the pot; which will bring away with it a little quantity of the glass, from whence the qualities may be judged of. And if there appear any defects, that seem owing to the want of a due conversion of the ingredients to a vitrious state, more time and heat must be given to it. But if no such defects are found, and the glass appear perfect, the fire should be decreased, and, by degrees, suffered to go out; and the pots continued in the furnace, till they become cold: after which, the pot should be torn off from the mass of glass contained in it. As, however, it is not always convenient to discontinue the heat of the furnace, when one or more pots of the glass may have attained to the due state of vitrification; they may, on such occasions, be taken out. And if the glass be not of great value, nor intended for very nice purposes, it may be formed into cakes, by pouring it on a clean plate of iron or copper, or into rolls. These cakes, or rolls, should be put into a moderate heat, before they grow cold; and continued there for some time, that they may gain a good temper, so as to bear cutting or working in any way, according to the use they are intended for.

The transparent coloured glass is in most cases improved, by continuing it in the heat, even for a considerable time after the vitrification seems perfected; as it is, by that means, rendered harder, and freer from specks and bubbles. But the semi-transparent kinds, and opaque white, formed of arsenic, must be taken just at the point, when the ingredients are duly united; for a more mature vitrification converts to transparent glass

the whole, or part of those substances, which should not be brought to that state. But as I have before intimated in what particular casts this requires to be most attended to, it is needful to enlarge further on the matter here.

*Of colouring rock crystals for the imitation of gems.*]  
The far greater hardness of crystal than of any kind of glass, and the superior lustre of it to any but pastes, which are deplorably soft, have rendered the art of imparting to it the colour of gems, an object of frequent and eager pursuit: as great advantages might probably have arisen from it to the first inventors. There are two methods, by which it has been conceived there was a possibility of doing it: the one, by cementing; that is, impregnating the crystals by means of heat, with the proper tinging particles, under the form of steam: the other, by bringing the crystal to a state of fusion, thro' the means of heat aided by a strong flux; and combining it in that state with the proper colouring substances. Both of these have been pretended to be effected in a perfect manner: and very ostentatious accounts of them have been given to the public: though it is much to be feared, that so far from having carried this art to any degree of perfection, there is not hitherto known one single fact, or principle, that in the least seems to lead to the attainment of it. As the world has been made to believe, however, as well more lately as formerly, by persons of some authority, that both these methods have been practised with all the desired success. I will exhibit the particular manner in which each has been practised, by those who have been believed to be most the masters of these arts.

“Take of very yellow orpiment, and white arsenic, each two ounces, and of antimony and sal ammoniacum each one ounce; and having reduced them to powder, mix them well together, and put them into a large crucible. Over this mixture, lay the pieces of rock crystal; first such as are of the least size, then larger, and at the top the biggest; taking care, that those chosen for this purpose have no flaws nor foulness. This crucible



must then be covered by a lesser turned upside down upon it, in the bottom of which, there should be previously made a little opening of the bigness of a pea ; in order that this bottom, becoming now the top of the vessel, formed by joining the two together, the fumes of the matter contained may have vent through the hole ; and, consequently, being determined upwards, may pass through the crystals, and act upon them. The joints produced by inverting the lesser crucible into the greater should be luted ; and being dry, the vessel thus formed must be put in the midst of pieces of charcoal, in such manner, that the undermost crucible may be buried in them intirely ; and the uppermost half way. The coals must then be kindled, and the fire suffered to burn very gradually without blowing, unless it should be necessary to keep it from extinguishing ; to prevent which from happening too soon, the pieces of charcoal should be chosen large. As the fire rises, the mixture in the crucible will emit copious fumes: which being very noxious, must be carefully avoided : and to that end this operation should be always performed under a chimney ; the front of which should be brought so low, that all the smoke may be determined up it ; and not spread itself in the elaboratory, or other place. The fire must be kept up so long as any of these fumes appear to rise ; and then permitted to go gradually out ; and all access of cold air must be cautiously prevented. When the crucibles are grown intirely cold, but not before, the uppermost may be taken off ; and the crystal will be found coloured, some pieces like topazes, and some like rubies, and a variety of other stones."

It has been said, that the crystals thus coloured have been cut ; and produced fine imitations of the true stones : but the truth of the matter is, (notwithstanding all pretension to more) that they do appear, when taken out of the crucible, to be well coloured and beautiful ; yet on further examination it is found, that the whole effect is produced by a fallacious cause. For the crystals being cracked by the heat, it is almost universally the consequence of being exposed to this degree of heat,

the fumes having insinuated themselves into these cracks, and there producing the same effect as the paint used betwixt the two tables of doublets. the whole substance of the stone has the appearance of being tinged. But on due inspection, nevertheless, the crystals are found to be neither fit to be cut, on account of the flaws, nor to have acquired any colour, but what would instantly be destroyed on the separation of the several parts of the stones, into which they are divided by the cracks: so that this method, together with many others of the same kind for giving colours to crystals by cementation, will be found to elude the hopes of those, who try them with any confidence.

The other pretended method of colouring crystals, by fusing them, and imparting the various tinges to them, while in a melted state, is thus performed:

“Take of rock crystals any quantity; and put them in a covered crucible in a strong fire; where they must be continued for some time. Remove the crucible then out of the fire; and immediately throw the crystals into a vessel of clean cold water: from whence being again collected, they must be re calcined; and afterwards thrown into fresh water again in the same manner: and this operation must be repeated, till the crystals be so changed in their texture, by the flaws and cracks produced by the sudden change from heat to cold, that they may be easily levigated. Powder the crystals thus calcined; and, to three pounds of them, add two pounds of purified pearl-ashes, or a pound and a quarter of red lead, together with any of the tinging substances above-mentioned, in the proportion directed for colouring glass or pastes; and fuse them in the same manner also, as has been before advised for other compositions. If the matter be found too difficult to be brought to a vitreous state, by this proportion of pearl-ashes or lead, borax or arsenic may be added, as in other cases, in order to form a more powerful flux.”

The crystal thus treated produces however nothing more than a glass exactly of the same kind with that formed of the Lynn sand; which is in fact no other

than a gross powder of crystal; and neither of them differ very essentially from such calcined flints, as are wholly free from colour. The supposition, therefore, that the crystal can be fused by this means, and being tinged while in that state, reduced afterwards to its original hardness, is wholly groundless. For it cannot be fused by the heat of furnaces without the medium of some fluxing body added to it; and then its texture and properties are so changed, or rather the glass produced by the composition is so different from the crystal itself, that there does not appear to be the least advantage in employing rock-crystal, in forming such a composition, preferably to flints; even if they could be procured at the same expence; and required no greater trouble or labour in their use.

*Of doublets.*] The impracticability of imparting tinges to the body of crystals, while in their proper and natural state, and the softness of glass which renders ornaments made of it greatly inferior in wear to crystal, gave inducements to the introduction of colouring the surface of crystal, wrought into a proper form in such manner, that the surfaces of two pieces so coloured being laid together, the effect might appear the same, as if the whole substance of the crystal had been tinged. The crystals (and sometimes white transparent glass) so treated, were called doublets: and at one time prevailed greatly in use, on account of the advantages, with respect to wear, such doublets had, when made of crystal, over glass, and the brightness of the colours, which could with certainty be given to counterfeit stones this way, when coloured glass could not be procured; or at least not without a much greater expence. Doublets have not indeed the property which the others have of bearing to be set transparent; as is frequently required in drops of ear-rings and other ornaments. But when mounted in rings, or used in such manner, that the sides of the pieces, where the joint is made, cannot be inspected, they have, when formed of crystal, the title to a preference to the coloured glass: and the art of managing them is therefore in some degree of the same

importance with that of preparing glass for the counterfeiting gems; and is therefore properly an appendix to it, as being intirely subservient to the same intention. The manner of managing doublets is as follows:

Let the crystal or glass be first cut by the lapidaries in the manner of a brilliant; except that, in this case, the figure must be composed from two separate stones, or parts of stones formed in the manner of the upper and under parts of a brilliant, if it was divided in an horizontal direction, a little lower than the middle. After the two plates of the intended stone are thus cut, and fitted so exactly, that no division can appear when they are laid together, the upper part must be polished ready for setting; and then the colour must be put betwixt the two plates by this method:

“Take of Venice or Cyprus turpentine two scruples; and add to it one scruple of the grains of mastic chosen perfectly pure, and free from foulness, and previously powdered. Melt them together in a small silver or brass spoon ladle, or other vessel, and put to them gradually any of the coloured substances below mentioned, being first well powdered; stirring them together as the colour is put in, that they may be thoroughly commixt. Warm then the doublets to the same degree of heat, as the melted mixture; and paint the upper surface of the lower part; and put the upper one instantly upon it; pressing them to each other; but taking care that they may be conjoined in the most perfectly even manner. When the cement or paint is quite cold, and set, the redundant part of it, which has been pressed out of the joint of the two pieces, should be gently scraped off the side, till there be no appearance of any colour on the outside of the doublets: and they should then be skilfully set; observing to carry the mounting over the joint, that the upper piece may be well secured from separating from the under one.”

The colour of the ruby may be best imitated, by mixing a fourth part of carmine with some of the finest crimson lake that can be procured: which may be best made for this purpose of Brazil wood.

The sapphire may be counterfeited by very bright Prussian blue, mixed with a little of the above-mentioned crimson lake; to give it a cast of the purple. The Prussian blue should not be very deep coloured, or but little of it should be used: for otherwise, it will give a black shade that will be injurious to the lustre of the doublets.

The emerald may be well counterfeited by distilled verdigrise, with a little powdered aloes. But the mixture should not be strongly heated, nor kept long over the fire after the verdigrise is added: for the colour is apt to be soon impaired by it.

The resemblance of the garnet may be made by dragon's blood: which, if it cannot be procured of sufficient brightness, may be helped by a very small quantity of carmine.

The vinegar garnet may be imitated with great success by the orange lake.

The amethyst may be counterfeited by the mixture of some Prussian blue, with the crimson lake: but the proportions can only be regulated by discretion; as different parcels of the lake and Prussian blue vary extremely in the degree of strength of the colour.

The yellow topazes may be imitated, by mixing the powdered aloes with a little dragon's blood; or by good Spanish anatto; but the colour must be very sparingly used, or the tinge will be too strong for the appearance of that stone.

The crysolite, hyacinth, vinegar garnet, eagle marine, and other such weaker or more diluted colours, may be formed in the same manner, by lessening the proportions of the colours, or by compounding them together correspondently to the hue of the stone to be imitated; to which end it is proper to have an original stone, or an exact imitation of one at hand, when the mixture is made; in order to the more certain adapting the colours to the effect desired. When these precautions are taken, and the operation well conducted, it is practicable to bring the doublets to so near a resemblance of the true stone, that even the best judges cannot



distinguish them, when well set, without a peculiar manner of inspection.

Where any kind of lake, or Prussian blue, is used for this purpose, it is best to grind or levigate it with spirit of turpentine instead of water: which will prevent its concreting again as it dries. The dragon's blood may be levigated with water: but the distilled verdigrise must be powdered dry. All the substances used as tinges for doublets or foils must, however, be powdered as finely as possible: the brightness of the counterfeit stones for which they are used, depending very greatly on that.

There is, however, an easy method of distinguishing doublets: which is only to hold them betwixt the eye and light, in such position, that the light may pass through the upper part, and corners of the stone; which will then show such parts to be white; and that there is no colour in the body of the stone.

*Of the general nature and preparation of foils.*] Foils are thin plates or leaves of metal, that are put under stones, or compositions in imitation of stones, when they are set.

The intention of foils is, either to increase the lustre or play of the stones, or more generally to improve the colour, by giving an additional force to the tinge, whether it be natural or artificial, by that of a ground of the same hue; which the foil is in this case made to be.

There are consequently two kinds of foils. The one is colourless; where the effect of giving lustre or play to the stone is produced by the polish of the surface, which makes it act as a mirror; and, by reflecting the light, prevent that deadness which attends the having a duller ground under the stone; and brings it, by the double refraction of the light that is caused, nearer to the effect of the diamond. The other is coloured with some pigment or stain of the same hue as the stone; or of some other, which is intended to modify and change the hue of the stone in some degree; as, where a yellow foil may be put under green, which is too much inclining to

the blue ; or under crimson, where it is desired to have the appearance more orange or scarlet.

Foils may be made of copper or tin : and silver has been sometimes used ; with which it has been advised, for some purposes, to mix gold ; but the expence of either is needless, as copper may be made to answer the same end.

Where coloured foils are wanted, copper may, therefore, be best used ; and may be prepared for the purpose by the following means :

“ Take copper plates beaten to a proper thickness ; and pass them betwixt a pair of fine steel rollers very closely set ; and draw them as thin as is possible to retain a proper tenacity. Polish them with very fine whiting, or rotten stone, till they shine, and have as much brightness as can be given them ; and they will then be fit to receive the colour.”

But where the yellow or rather orange colour of the ground would be injurious to the effect, as in the case of purples, or crimson red, the foil should be whitened, which may be done by silvering it in the following manner :

“ Take a small quantity of silver, and dissolve it in aquafortis ; and then put bits of copper into the solution, to precipitate the silver ; which being thus precipitated, the fluid must be poured off : and fresh water added to it, to wash away all the remainder of the first fluid : after which, the silver must be dried. An equal weight of cream of tartar, and common salt, must then be ground with it, till the whole be reduced to a very fine powder : and with this mixture, the foils, being first slightly moistened, must be rubbed by the finger, or a bit of linen rag, till they be of the degree of whiteness desired : after which, if it appear to be wanted, the polish must be refreshed.”

Instead of rolling, the more general practice is, to beat the copper plates, previously heated, betwixt two flat irons on an anvil, till they become of the thickness required ; and then give to them an even surface, by a planishing hammer, before they are polished : but the

use of the rollers is much more expeditious and effectual, where the quantity demanded can defray the expence of purchasing them, with the other necessary work.

The tin foils are only used in the case of colourless stones, where quicksilver is employed: and they may be drawn out by the same rollers; but need not be further polished; as that effect is produced by other means in this case.

*Of the colouring foils.*] There have been two methods invented for the colouring foils: the one by tinging the surface of the copper of the colour required, by means of smoke; the other by staining or painting it with some pigment, or other colouring substance. The first is limited only to colours where blue is prevalent, and, being troublesome and uncertain in the production, is not, on the whole, so eligible, in any case, as the latter: and I shall, therefore, omit giving any directions for the practice of it; as all colours desired may be given to the foils by the other method: that is, by laying a pigment or other colouring substance on the surface, by means of some proper vehicle that may serve for spreading it, and fixing it to the copper as a cement.

The colours used for painting foils, may be tempered with either oil; water rendered duly viscid by gum Arabic, or size, or varnish: and as there is no preference of one method to the other, but in particular cases, it is best to peruse all of them, according to the occasions that may be best served. Where deep colours are wanted, oil is most proper; because some pigments become wholly transparent in it; as lake or Prussian blue: but yellow and green may be better laid on in varnish, as the yellow may be had in perfection from a tinge wholly dissolved in spirit of wine, in the same manner as in the case of laquers; and the most beautiful green is to be produced by distilled verdigrise, which is apt to lose its colour, and turn black with oil. In common cases, however, any of the colours may be, with little trouble, laid on with isinglass size, in the same manner as the glazing colours used in miniature painting; for

which, ample directions will now be given. The best method of adapting foils to all the several purposes, is as follows:

For red, where the ruby is to be imitated, carmine, with a little lake used in isinglass size, or shell-lac varnish, is to be employed, if the glass or paste be of a full crimson, verging towards the purple. But if the glass incline to the scarlet, or orange, very bright lake (that is not purple) may be used alone in oil.—For the garnet red, dragon's blood, dissolved in seed-lac varnish, may be used:—and for the vinegar garnet, the orange lake, tempered with shell-lac varnish, will be found excellent.

For the amethyst, lake, with a little Prussian blue, used with oil, and very thinly spread on the foil, will completely answer the end.

For blue, where a deep colour, or the effect of the sapphire is wanted, Prussian blue, that is not too deep, should be used in oil: and it should be spread more or less thinly on the foil, according to the lightness or deepness of which the colour is desired to be.—For the eagle marine, common verdigrise, with a little Prussian blue, tempered in shell lac varnish, may be used.

For yellow, where a full colour is desired, the foil may be coloured with yellow laquer, laid on as for other purposes: and for the slighter colour of topazes, the burnish and foil itself will be sufficiently strong without any addition.

For green, where a deep hue is required, the crystals of verdigrise, tempered in shell-lac varnish, should be used: but where the emerald is to be imitated, a little yellow laquer should be added, to bring the colour to a truer green, and less verging to the blue.

The stones of more diluted colour, such as the amethyst, topaz, vinegar garnet, and eagle marine, may be very cheaply imitated by transparent white glass, or paste, even without foils. This is to be done, by tempering the colours above enumerated with turpentine and mastic, treated in the manner directed as before, for doublets; and painting the socket in which the coun-

terfeit stone is to be set with the mixture ; as well that as the socket and stone itself being previously heated. In this case, however, the stone should be immediately set, and the socket closed upon it, before the mixture cool and grow hard.

The orange lake, abovementioned, was invented for this purpose, in which it has a beautiful effect ; and was used with great success by a considerable manufacturer. The colour it produces is that of the vinegar garnet ; which it affords with great brightness.

The colours, above directed to be used in oil, should be extremely well ground in oil of turpentine, and tempered with old nut or poppy oil ; or, if time can be given for their drying, with strong fat oil diluted with spirit of turpentine, which will gain a fine polish of itself.

The colours used in varnish should be, likewise, thoroughly well ground and mixed : and, in case of the dragon's blood, in the seed-lac varnish and the laquer, the foils should be warmed before they are laid on.

All the mixtures should be laid on the foils with a broad soft brush ; which must be passed from one end to the other ; and no part should be crossed, or twice gone over ; or, at least, not till the first coat be dry ; when, if the colour do not lie strong enough, a second coat, or even a third, may be given.

*Of foils for crystals, pebbles, or paste, to give the lustre and play of diamonds.*] The manner of preparing foils, so as to give colourless stones the greatest degree of play and lustre, is, by raising so high a polish or smoothness on the surface, as to give them the effect of a mirror ; which can only be done in a perfect manner by the use of quicksilver applied in the same general way, as in the case of looking-glasses. The method by which it may be best performed, is as follows :

“ Take leaves of tin, prepared in the same manner as for silvering looking-glasses ; and cut them into small pieces of such size as to cover the surface of the socket of the stones that are to be set. Lay three of these then one upon another ; and, having moistened the



inside of the socket with thin gum water, and suffered it to become again so dry, that only a slight stickiness remains, put the three pieces of leaves, lying on each other, into it, and adapt them to the surface, in as even a manner as possible. When this is done, heat the socket, and fill it with warm quicksilver; which must be suffered to continue in it three or four minutes, and then gently poured out. The stone must then be thrust into the socket, and closed with it; care having been taken to give such room for it, that it may enter without stripping off the tin and quicksilver from any part of the surface. The work should be well closed round the stone, to prevent the tin and quicksilver, contained in the socket, from being shaken out by any violence."

The lustre of stones, set in this manner, will continue longer, than when they are set in the common way; as the cavity round them being filled in this manner, there will be no passage found for moisture; which is so injurious to the wear of stones treated in any other way.

This kind of foil gives some lustre to glass, or other transparent matter, which has little of itself: but to stones, or pastes, that have some share of play, it gives a most beautiful brilliance. It has been but little practised hitherto; I suppose from an ignorance of the manner of doing it: for, indeed, I never heard of more than one person, and he is now some time deceased, who performed it to perfection: and he gave the stones a surprising lustre, that made them not distinguishable from diamonds even by day light. There is, nevertheless, at present, one disadvantage attending this method, as it is now practised: which is, that it can be only performed in the case of stones with a flat bottom. In consequence of which, the rose or table diamonds, only, can be imitated by it. But though the manner of doing it has not been hitherto discovered, yet it is certainly not impossible to contrive some way of setting stones of the cut of brilliants in this manner: in which case, if any of the crystal species, such as

those called Bristol stones, Kerry stones, &c. were to be used, their far greater hardness, as well as much higher lustre, when treated in this way, would render them far superior to pastes.

## Of Cements.

**C**EMENTS require to be of very various compositions, and different with respect to the nature of the ingredients, according to the different manner in which they are to be applied ; and the substances they are to conjoin. The kinds of cement used for common purposes pass under the denomination of glues, sizes, pastes, and lutes : but some, that are used for extraordinary occasions, retain only the general name of cements.

*Preparation of isinglass glue.*] “ Isinglass glue is made by dissolving beaten isinglass in water by boiling ; and, having strained it through a coarse linen cloth, evaporating it again to such a consistence, that, being cold, the glue will be perfectly hard and dry.”—A great improvement is said to be made in this glue by adding spirit of wine or brandy to it after it is strained, and then renewing the evaporation till it gain the due consistence. Some soak the isinglass in the spirit of brandy for some time before it is dissolved, in order to make the glue ; and add no water, but let the spirit supply the place of it. But it is not clear, from trial, that either of these practices render the glue better. This isinglass glue is far preferable to common glue for nicer purposes ; being much stronger, and less liable to be softened either by heat or moisture.

*Preparation of parchment glue.*] “ Take one pound of parchment, and boil it, in six quarts of water, till the quantity be reduced to one quart : strain off the fluid from the dregs ; and then boil it again, till it be of the consistence of glue.”—The same may be done with glovers’ cuttings of leather, which make a colourless glue, if not burned in the evaporation of the water.

*Preparation of a very strong compound glue.*] “Take common glue in very small or thin bits, and isinglass glue; and infuse them in as much spirit of wine as will cover them, for at least twenty-four hours. Then melt the whole together; and, while they are over the fire, add as much powdered chalk as will render them an opake white.”—The infusion in the spirit of wine has been directed in the recipes given for this glue; but the remark on the use of it in the preceding article will hold good also in this: and the mixture may be made with water only.

*Preparation of a very strong glue that will resist moisture.*] “Dissolve gum sandrac, and mastic, of each two ounces, in a pint of spirit of wine; adding about an ounce of clear turpentine. Then take equal parts of isinglass, and parchment glue, made according to the directions in the preceding article; and, having beaten the isinglass into small bits, as for common uses, and reduced the glue to the same state, pour the solution of the gums upon them; and melt the whole in a vessel well covered; avoiding so great a heat as that of boiling water. When melted, strain the glue through a coarse linen cloth; and then putting it again over the fire, add about an ounce of powdered glass.”—This preparation may be best managed in balneo mariæ, which will prevent the matter burning to the vessel; or the spirit of wine from taking fire: and indeed it is better to use the same method for all the evaporations of nicer glues, and sizes; but, in that case, less water than the proportion directed, should be added to the materials. A very strong glue, that will resist water, may be also made by adding half a pound of common glue or isinglass glue to two quarts of skimmed milk, and then evaporating the mixture to the due consistence of the glue.

*Preparation of lip glue, for extemporaneously cementing paper, silk, and thin leather, &c.*]—“Take of isinglass glue, and parchment glue, each one ounce, of sugar candy, and gum tragacanth, each two drachms, Add to them an ounce of water, and boil the whole together, till the mixture appear, when cold, of the pro-

per consistence of glue. Then form it into small rolls, or any other figure, that may be most convenient."—This glue being wet with the tongue, and rubbed on the edges of the paper, silk, &c. that are to be cemented, will, on their being laid together, and suffered to dry, unite them as firmly as any other part of the substance.

*Of sizes.*] Common size is manufactured in the same manner, and generally by the same people, as glue. It is indeed glue left in a moisture state, by discontinuing the evaporation before it is brought to a dry consistence: and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared, in the manner above directed for the glue, by increasing the proportion of the water for dissolving it: and the same holds good of parchment size. A better sort of the common size, which may be likewise made by treating cuttings of glovers' leather in the same manner.

*Of pastes.*] Paste for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence. It may be prepared of those ingredients simply for common purposes: but when it is used by book-binders, or for paper hangings to rooms, it is usual to mix a fourth, fifth or sixth of the weight of the flower of powdered resin; and where it is wanted still more tenacious, gum Arabic, or any kind of size, may be added. In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixed with it. But the most effectual and easy remedy is to dissolve a little sublimate, in the proportion of a drachm to a quart, in the water employed for making the paste; which will hinder, not only rats and mice, but any other kind of vermin and insects, from preying on the paste.

*Of lutes.*] Lutes are cements employed for making good the joints of glasses put together, or other such purposes, in chemical operations. In a general view,

the preparation of them properly belongs to the art of chemistry only : but as they are nevertheless sometimes used in other arts, it may be expedient to show here the manner of compounding them. In the making good junctures, where the heat is not sufficient to burn paper or vegetable substances, the following mixture, which is easily made, will effectually answer the purpose. Take a mixture of linseed meal or wheaten flour and whiting, in the proportion of one part of the first to two of the last, tempered with a solution of gum Senegal or Arabic in water, and spread upon the joint, a narrow piece smeared with the same being put over it and pressed close. A piece of bladder smeared with gum water, or the glair of eggs, and fitted to the glasses over the joint, will also answer the same end. But in the rectification of spirit of wine, or other such volatile substances, where the waste made by the escape of the vapour may be material, a stronger lute formed of quicklime, tempered to a proper consistence with drying oil, should be used. This mixture should be made at the time it is wanted, as it very soon becomes dry and untractable : and great care must be taken, where it is employed, to manage the heat in such manner, that the vapour may not rise so fast as to heat the vessels beyond the due point ; for this lute renders the glasses joined together by it as one intire body ; and will resist the expansive force of the vapour to so great a degree, that the glasses will frequently burst before it will give way. Where lute is to be used in places liable to be so heated as to burn vegetable or animal substances, it may be thus compounded. Take two parts of green vitriol calcined to redness, one part of the scoria or clinkers of a smith's forge well levigated, and an equal quantity of Windfor loom or Sturbridge clay dried and powdered : temper them to a proper consistence with the blood of any beast ; some short hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them, and spread them over the juncture. In cases of little importance, a composition of sand, clay, and dung of horses tempered with water, may be used.



*Preparation of cement for joining broken glasses, china, &c.*] The cement, which has been most approved for uniting glass, china, or earthen ware, as also the parts of metalline bodies (where soldering is not expedient) is thus prepared.—“Take two ounces of good glue, and steep it for a night in distilled vinegar: boil them together the next day; and having beaten a clove of garlic with half an ounce of ox-gall into a soft pulp, strain the juice through a linen cloth, using pressure, and add it to the glue and vinegar. Take then of sanderac powdered, and turpentine, each one drachm, and of sarcocol, and mallic, powdered, each half a drachm; and put them into a bottle with an ounce of highly rectified spirit of wine. Stop the bottle; and let the mixture stand for three hours in a gentle heat; frequently shaking it. Mix this tincture also with the glue while hot; and stir them well together with a stick or tobacco-pipe, till part of the moisture be evaporated; and then take the composition from the fire; and it will be fit for use. When this cement is to be applied, it must be dipped in vinegar; and then melted in a proper vessel, with a gentle heat; and if stones are to be cemented, it is proper to mix with it a little powdered tripoli or chalk; or, if glass is to be conjoined, powdered glass should be substituted.”—I see no reason why common vinegar should not be equally proper for this purpose with the distilled; nor indeed am I very certain that vinegar improves at all the cementing property of the composition. For the uniting the parts of broken china or earthen ware vessels, as also glass where the rendering the joint visible is not of consequence, the following composition, which is much more easily prepared, may be substituted for the foregoing: “Take an ounce of cheese, devoid of fat: grate it as small as possible; and put it, with an equal weight of quicklime, into three ounces of skimmed milk. Mix them thoroughly together; and use the composition immediately.”—Where the broken vessels are for service only, and the appearance is not to be regarded, the joints may be made equally strong with any other part

of the glass, by putting a slip of thin paper, or linen, smeared with this cement, over them, after they are well joined together by it. This method will make a great saving in the case of glasses employed for chemical, or other similar operations. A cement of the same nature may be made by tempering quicklime with the curd of milk, till it be of a due consistence for use. The curd, in this case, should be as free as possible from the cream or oil of the milk. On this account it should be made of milk from which the cream has been well skimmed off; or the kind of curd commonly sold in the markets, made of whey, and the milk from which butter has been extracted, commonly called butter-milk. This cement should be used in the same manner as the preceding: and they may be applied to stones, marble, &c. with equal advantage as the more compound one above given, and is much more easily and cheaper prepared. Drying oil with white lead is also frequently used for cementing china, and earthen-ware: but where it is not necessary the vessels should endure heat or moisture, isinglass glue with a little tripoli or chalk is better.

*Preparation of common cement for joining alabaster, marble, porphyry or other stones.*] “Take of bees wax two pounds, and of resin one pound. Melt them; and add one pound and a half of the same kind of matter powdered, as the body to be cemented is composed of; strewing it into the melted mixture, and stirring them well together; and afterwards kneading the mass in water, that the powder may be thoroughly incorporated with the wax and resin. The proportion of the powdered matter may be varied, where required, in order to bring the cement nearer to the colour of the body on which it is employed.”—This cement must be heated when applied; as must also the parts of the subject to be cemented together; and care must be taken, likewise, that they be thoroughly dry. It appears to me, that the proportion of the bees wax is greater than it ought to be: but I received this recipe from too good an authority to presume to alter it. When this composition is properly managed, it forms an extremely good ce-

ment, which will even suspend a projecting body of considerable weight, after it is thoroughly dry and set : and is therefore of great use to all carvers in stone, or others who may have occasion to join together the parts of bodies of this nature.

*Of cements for rock-work, reservoirs, and other such purposes.]* A variety of compositions are used as cements for purposes of this kind : in the application of which, regard should be had to the situation where they are employed with respect to moisture and dryness ; as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fissures that are to be made good. Where a great quantity of cement is wanted for coarser uses, the coal-ash mortar (or Welsh tarras as it is called) is the cheapest and best ; and will hold extremely well, not only where it is constantly kept wet or dry ; but even where it is sometimes dry and at others wet. But where it is liable to be exposed to wet and frost, this cement should, at its being laid on, be suffered to dry thoroughly before any moisture have access to it ; and, in that case, it will likewise be a great improvement to temper it with the blood of any beast. This mortar or Welsh tarras must be formed of one part lime and two parts of well-sifted coal ashes ; and they must be thoroughly mixed by being beaten together : for, on the perfect commixture of the ingredients, the goodness of the composition depends. Where the cement is to remain continually under water, the true tarras is commonly used ; and will very well answer the purpose. It may be formed of two parts of lime, and one part of plaister of Paris : which should be thoroughly well beaten together ; and then used immediately. For the fixing shells, and other such nice purposes, putty is most generally used. It may be formed for this purpose of quicklime, and drying oil, mixed with an equal quantity of linseed oil ; or, where the drying quicker is not necessary, it may be made with lime and crude linseed oil, without the drying oil. The stone cement, prepared as above of the bees wax and

resin, is also an extremely good composition for this purpose. But resin, pitch, and brick-dust, in equal parts, melted together and used hot, are much the cheapest cement for shell-work; and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are used.

## END of the THIRD PART.

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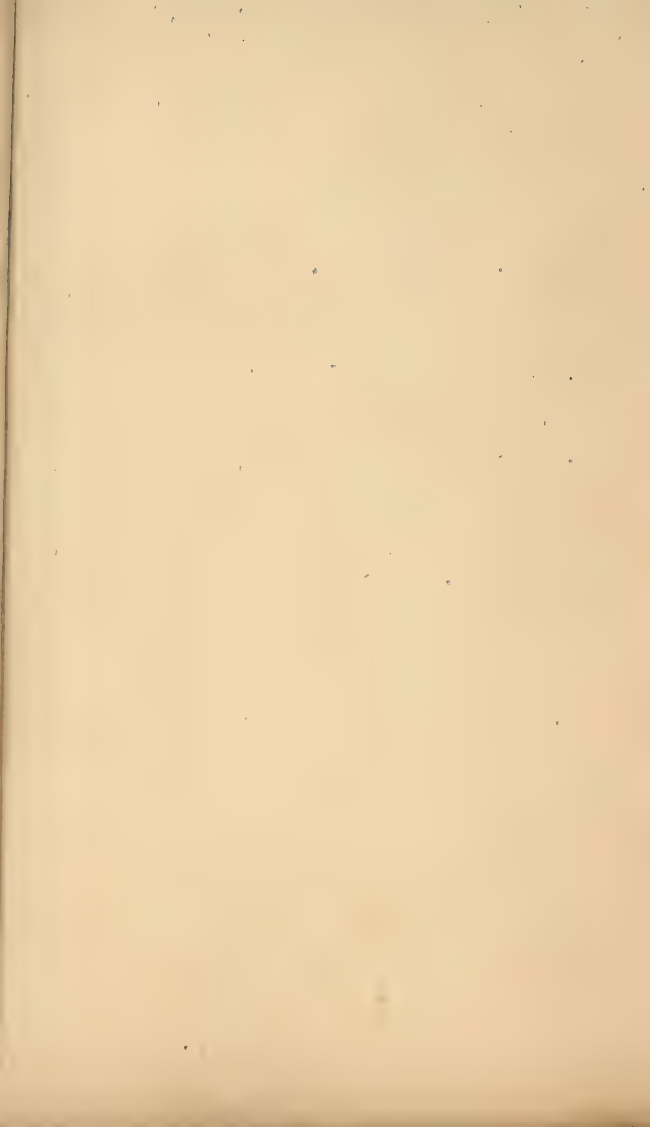
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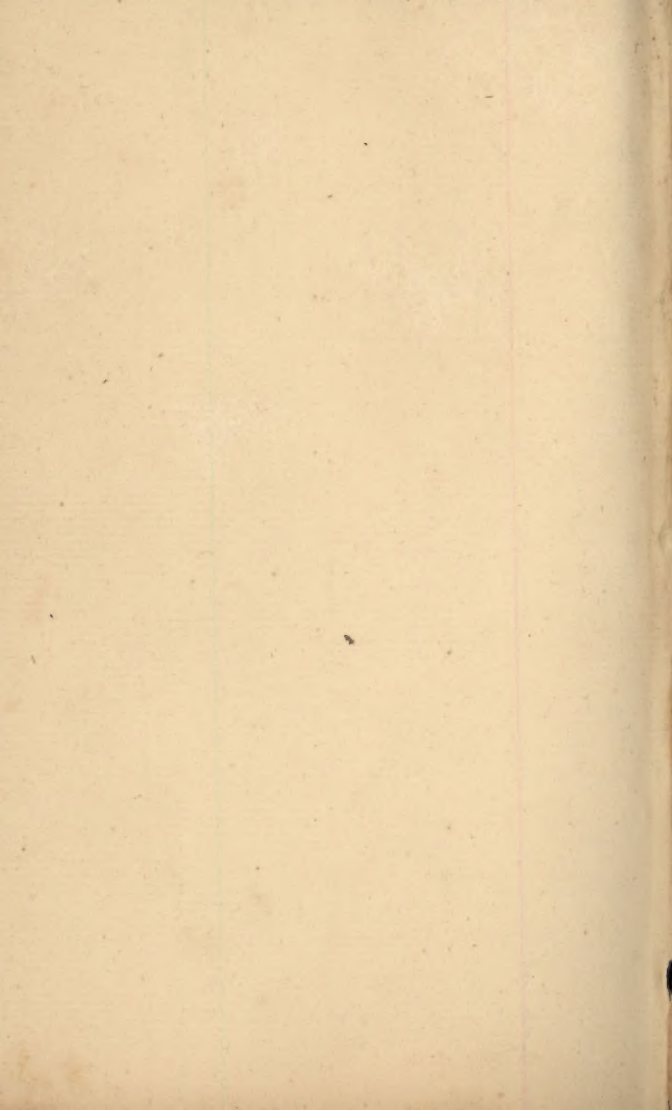
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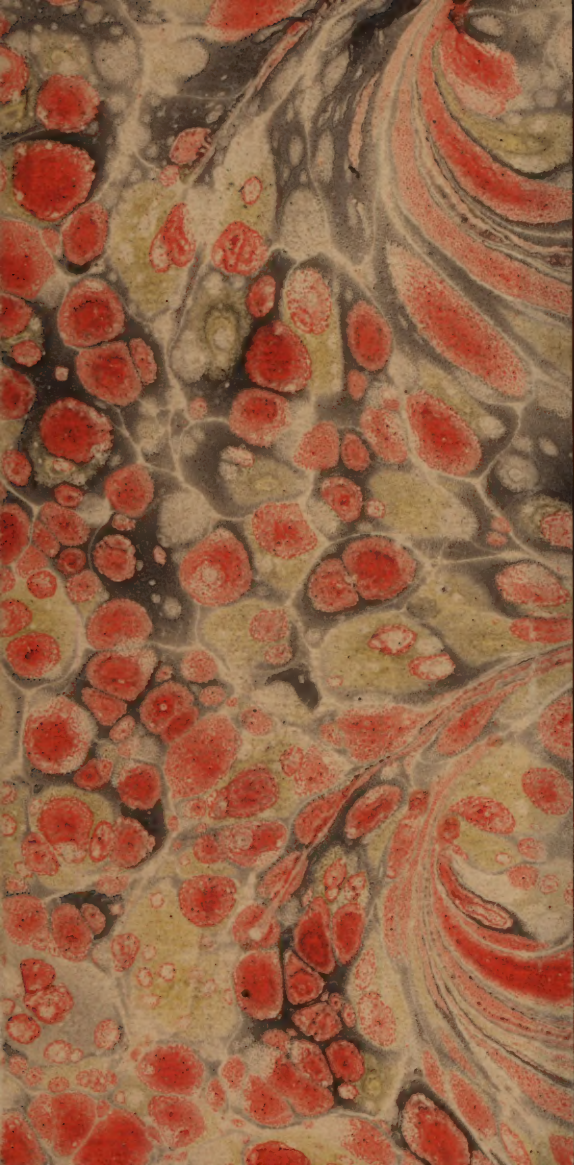
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